NUCLEAR SCIENCE ABSTRACTS

Final Issue

Volume 33 Number 12

Abstracts 28272-32604

June 30, 1976

FINAL VOLUME
See Notice Inside

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

REPORT COLLECTIONS IN THE UNITED STATES

The libraries listed below purchase and maintain microfiche collections of ERDA and foreign reports that are abstracted in *NSA*. Their collections also include *NSA* and its indexes, ERDA's Technical Progress Reviews, ERDA-sponsored translations, conference proceedings published by ERDA, and various bibliographic tools. Most of these libraries have microfiche reader-printers or other photocopy facilities with which to reproduce enlarged copies from microfiche. Charges for reproduction services vary.

Report collections of ERDA reports in countries other than the United States are listed on the inside back cover.

ALABAMA
Auburn, Auburn University
Tuskegee Institute, Tuskegee Institute

ARIZONA
Tucson, University of Arizona

CALIFORNIA
Davis, University of California
Los Angeles, University of California
Santa Barbara, University of California

COLORADO
Boulder, University of Colorado

DISTRICT OF COLUMBIA
Washington, Library of Congress

FLORIDA
Gainesville, University of Florida

GEORGIA
Atlanta, Georgia Institute of Technology

HAWAII
Honolulu, University of Hawaii

IDAHO
Pocatello, Idaho State University

ILLINOIS
Urbana, University of Illinois

INDIANA
Lafayette, Purdue University

IOWA
Ames, Iowa State University

KANSAS
Manhattan, Kansas State University

KENTUCKY
Lexington, University of Kentucky

MARYLAND
Baltimore, Johns Hopkins University
College Park, University of Maryland

MASSACHUSETTS
Cambridge, Massachusetts Institute of Technology
Worcester, Worcester Polytechnic Institute

MICHIGAN
Ann Arbor, University of Michigan

MISSISSIPPI
State College, Mississippi State University

MISSOURI
Columbia, University of Missouri
Kansas City, Linda Hall Library

NEW JERSEY
Princeton, Princeton University

NEW MEXICO
Albuquerque, University of New Mexico

NEW YORK
Albany, New York State Library
Albany, State University at Albany
Ithaca, Cornell University
New York, Columbia University
Rochester, University of Rochester
Syracuse, Syracuse University

NORTH CAROLINA
Raleigh, North Carolina State University

OHIO
Cincinnati, University of Cincinnati
Cleveland, Cleveland Public Library
Toledo, University of Toledo

OKLAHOMA
Norman, University of Oklahoma

PENNSYLVANIA
Philadelphia, University of Pennsylvania
Pittsburgh, Carnegie Library
University Park, Pennsylvania State University

PUERTO RICO
San Juan, University of Puerto Rico

SOUTH CAROLINA
Columbia, University of South Carolina

TENNESSEE
Knoxville, University of Tennessee

TEXAS
Austin, University of Texas
College Station, Texas A & M University
Houston, Rice University

UTAH
Salt Lake City, University of Utah

VIRGINIA
Blacksburg, Virginia Polytechnic Institute
Charlottesville, University of Virginia

WASHINGTON
Pullman, Washington State University
Seattle, University of Washington

WEST VIRGINIA
Morgantown, West Virginia University

WISCONSIN
Madison, University of Wisconsin

ERDA reports so indicated in *Nuclear Science Abstracts* are offered for sale by National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161.

NOTICE

A title page for Volume 33, Numbers 7–12, is included at the back of this issue for use in binding those issues.

CORRECTIONS

NSA Vol. 33, No. 7, Abst. 15209, line 1 should read: SUPERCONDUCTIVITY IN THE $RE_xMo_6S_8$. Fischer, O.

NSA Vol. 33, No. 8, Abst. 17763, line 2 should read: TIGATIONS OF $Dy(Fe_{1-x}Co_x)_3$ AND $Y(Fe_{1-x}Co_x)_3$

NSA Vol. 33, No. 8, Abst. 17763, line 3 should read: INTERMETALLIC COMPOUNDS. Arif, S. K.; Bunbury,

Volume 33, Number 12, June 30, 1976

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USERDA Office of Public Affairs
Published by the ERDA Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the ERDA Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

Atomic Energy of Canada Limited
Australian Atomic Energy Commission
Danish Atomic Energy Commission
Finnish Atomic Energy Commission
French Atomic Energy Commission
Japan Atomic Energy Bureau–Atomic Energy Research Institute
Commissie Nucleaire Informatieverzorging (Netherlands)
Institutt for Atomenergi (Norway)
Aktiebolaget Atomenergi (Sweden)
United Kingdom Atomic Energy Authority
Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

NOTICE

The publication of *Nuclear Science Abstracts* is planned to be discontinued after Vol. 33, No. 12, dated June 30, 1976. *Atomindex*, published by the International Atomic Energy Agency and a product of the International Nuclear Information System (INIS), will provide essentially identical literature coverage, subject scope, abstracting and indexing with that of *NSA*. For all practical purposes the two journals are identical. The Energy Research and Development Administration, formerly the Atomic Energy Commission, has supported the concept and development of INIS for several years. At this time, it is quite apparent that the decentralized scanning, abstracting and indexing on a country-by-country basis is reliable and successful. Consequently, it is no longer necessary for the United States to bear the entire burden of publishing an abstract journal covering the world's nuclear literature. ERDA will continue to provide coverage of U. S. nuclear literature to INIS.

Atomindex is available on a subscription basis in the United States from UNIPUB, P. O. Box 433, Murray Hill Station, New York, New York 10016, for $150 per year including cumulative indexes. ($110 per year without cumulative indexes.) For others, *Atomindex* is available from the International Atomic Energy Agency, Publications Section, P. O. Box 590, A-1011, Vienna, Austria, at the same price.

ERDA's new journal, *ERDA Energy Research Abstracts (ERA)*, will contain abstracts and indexes to all literature of ERDA origin as well as nonnuclear energy information generated by foreign countries with which ERDA has agreements for cooperation. *ERA* is available to government agencies on the same basis as *NSA* and on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information.

The public may obtain *ERA* from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. The annual subscription rate for the 12 regular issues including an annual cumulative index is $119 for domestic subscribers, and $148.75 for foreign subscribers. Individual issues will be priced at $7.40 domestic, and $9.25 foreign. Separate annual index cumulations will cost $30.50 domestic, and $38.15 foreign.

INDEXES TO *NSA*

Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SOLDAN, D.W., Shipping container for a bottle of radioactive material, 32:20442
SOLDAT, J.K., Dosimetry of the radioactive noble gases, 32:19918 (BNWL-SA-4813)
SOLOMAKHA, D.A., Measurement of the 1.15-μm wavelength of a helium--neon laser, 32:19555

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

URANIUM ORES/GEOCHEMISTRY
Change of uranium concentration in plagioclase of various zones of microcline--albite--oligoclase pegmatites of Karelia, 32:19704
URANIUM ORES/LEACHING
Preparation of uranium compounds (Patent), 32:19329
URANIUM ORES/MINING
The uranium mining and its importance for the energy supply, 32:19701
URANIUM ORES/ORE PROCESSING
Supplies for the fuel cycle for Spanish nuclear power plants, 32:19702
URANIUM OXIDES
See also URANIUM DIOXIDE
URANIUM OXIDES U3O8

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

20457 (LA-5954) 100-MHz POWER AMPLIFIER DESIGN AND CONTROL FOR A HEAVY-ION ACCELERATOR, Lunsford, J. S.; Shipley, J. P.; Sutton, J. **(Los Alamos Scientific Lab., N. Mex. (USA)).** Jul 1975. 11p. Dep. NTIS $4.00.

is indexed as:

LOS ALAMOS SCIENTIFIC LAB., N.MEX. (USA)
100-MHz power amplifier design and control for a heavy-ion accelerator, 32:20457 (LA-5954)
Characterization of transuranic solid wastes from a plutonium processing facility, 32:19398 (LA-5993-MS)
Electrical breakdown and tracking characteristics of pulsed high voltages in cryogenic helium and nitrogen, 32:19495 (LA-UR-75-1032)
Engineering concepts for laser-fusion reactor applications, 32:19493 (LA-UR-75-736)
Evaluation of pre-impregnated resin-glass systems for insulating superconducting magnets, 32:19583 (LA-UR-75-1099)

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

L-	**(Misc.)**	
9389	**32:20494**	**See N-74-35219**
LA-		
2429	**32:20210**	**Dep. NTIS, $12.00**
5931	**32:21563**	**Dep. NTIS, $5.45**
LA-tr-		
75-14	**32:21506**	**Dep. NTIS, $7.75**
75-26	**32:19253**	**Dep. NTIS, $4.00**
LA-UR-		
75-736	**32:19493**	**Dep. NTIS, $4.00**
75-791	**32:20772**	**Dep. NTIS, $4.50**
75-1331	**32:19238**	**Dep. NTIS, $4.00**
LBL-		
2874	**32:19889**	**Dep. NTIS, $9.25**
3633	**32:21097**	**Dep. NTIS, $13.50**
LFEN-	**(Portugal)**	
165-b	**32:21507**	**INIS**

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 33, Number 12, June 30, 1976

Category	Page
CHEMISTRY	2815
Analytical and Separations Chemistry	2815
Activation and Nuclear Reaction Procedures	2816
Chemical and Spectral Procedures	2819
Radiometric and Radiochemical Procedures	2824
Separation Procedures	2825
Inorganic, Organic, and Physical Chemistry	2828
Chemical and Physicochemical Properties	2828
Isotope Effects	2832
Isotope Exchange and Isotope Separation	2834
Feed Materials Processing	2836
Radiation Chemistry	2836
Radiochemistry and Nuclear Chemistry	2843
Hot-Atom Chemistry	2844
Properties of Radioactive Materials	2844
Radioactive Waste Treatment	2847
Radioisotope Production	2848
Reactor Fuel Reprocessing	2849
CONTROLLED THERMONUCLEAR RESEARCH	2850
Plasma Confinement and Heating	2850
Plasma Diagnostics	2851
Plasma Kinetics (General)	2853
Plasma Kinetics (Experimental)	2854
Plasma Kinetics (Theoretical)	2854
Plasma Production	2856
Plasma Stability	2856
Thermonuclear Engineering and Equipment	2859
Wave Phenomena	2862
ENGINEERING	2865
Energy Conversion	2865
Facilities and Equipment	2865
Lasers	2866
Cryogenic and Superconducting Equipment and Devices	2879
Heat Transfer and Fluid Flow	2882
Materials Testing	2884
Nuclear Explosions	2885
Protective Structures and Equipment	2886
Safety Engineering	2887
Vacuum Engineering	2887
ENVIRONMENTAL AND EARTH SCIENCES	2888
Minerals and Ores	2888
Radioactivity Monitoring and Transport	2890
Atmosphere	2893
Soil	2896
Water	2896
Ecosystems and Food Cycles	2897
Radiometric Techniques	2897
Site Surveys	2898
Thermal Effluents	2898
Chemical Effluents	2899
INSTRUMENTATION	2902
Radiation Detection Instruments	2902
General Detectors and Monitors	2902
Radiation Dosimeters	2911
Nuclear Spectroscopic Instrumentation	2916
High Energy Physics Instrumentation	2920
Radiometric Instruments	2922
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	2925
Miscellaneous Instruments	2928
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	2931
Isotope Separation (Industrial)	2931
Isotopic Power Sources	2932
Radiation Sources	2933
Design and Fabrication	2933
Industrial Uses	2933
LIFE SCIENCES	2935
Radiation Effects on Biochemicals	2935
Radiation Effects on Cells	2938
Radiation Effects on Microorganisms	2940
Radiation Effects on Plants	2943
Radiation Effects on Animals	2946
Man	2946
Vertebrates	2954
Invertebrates	2960
Radionuclide Effects (Internal Source)	2962
Man	2962
Animals	2963
Nuclide Kinetics and Toxicology	2964
Man	2964
Animals	2964
Plants	2966
New Tracer Techniques	2966
MATERIALS	2984
Ceramics and Cermets	2984
Metals and Alloys	2992
Corrosion and Erosion	2992
Preparation and Fabrication	2995
Properties, Structure, and Phase Studies	2998
Radiation Effects	3012
Other Materials	3015
NUCLEAR MATERIALS AND WASTE MANAGEMENT	3025
Accountability and Safeguards	3025
Disposal and Storage	3025
Handling Equipment and Procedures	3026
Transportation	3028

TABLE OF CONTENTS (continued)

Category	Page
PARTICLE ACCELERATORS	3030
Design, Development, and Operation	3030
Auxiliaries and Components	3030
Ion Sources and Injection and Extraction Systems	3032
Ion Optics and Field Calculations	3035
Storage Rings	3036
Experimental Facilities	3036
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	3038
Cosmic Radiation	3038
Stars	3040
Quasi-Stellar, Radio, and X-Ray Sources	3053
Solar Phenomena	3056
Galaxies	3063
Cosmology	3069
Planetary Phenomena	3070
PHYSICS (ATMOSPHERIC)	3074
Auroral and Ionospheric Phenomena	3074
Effects of Nuclear Detonations	3085
Magnetospheric Phenomena	3085
PHYSICS (ATOMIC AND MOLECULAR)	3089
Beams and Their Reactions	3089
Atomic and Molecular Properties	3094
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	3098
Collision Phenomena	3099
Atomic Theory	3108
PHYSICS (ELECTROFLUID AND MAGNETOFLUID)	3111
PHYSICS (HIGH-ENERGY)	3113
Particle Interactions and Properties (Experimental)	3113
Electromagnetic	3113
Weak	3115
Strong (Baryon-induced)	3118
Strong (Meson-induced)	3120
Particle Interactions and Properties (Theoretical)	3123
General	3123
Electromagnetic	3128
Weak	3132
Strong (General)	3135
Strong (Baryon No. = 0)	3137
Strong (Baryon No. = 1)	3139
Strong (Baryon No. ≥ 2)	3140
Particle Invariance Principles and Symmetries	3141
General	3141
Applications (Electromagnetic and Weak)	3142
Applications (Strong)	3142
Scattering Theory	3142
PHYSICS (LOW-TEMPERATURE)	3146
Superfluidity	3146
Superconductivity	3146
PHYSICS (NUCLEAR)	3149
Neutron Interactions with Matter	3149
Nuclear Properties and Reactions, A < 5	3151
PHYSICS (NUCLEAR) (Cont'd.)	
Nuclear Properties and Reactions, 6 < A < 19	3153
Nuclear Properties and Reactions, 20 < A < 38	3157
Nuclear Properties and Reactions, 39 < A < 58	3159
Nuclear Properties and Reactions, 59 < A < 89	3161
Nuclear Properties and Reactions, 90 < A < 149	3163
Nuclear Properties and Reactions, 150 < A < 189	3167
Nuclear Properties and Reactions, 190 < A < 219	3168
Nuclear Properties and Reactions, A > 220	3170
Nuclear Theory	3172
PHYSICS (RADIATION AND SHIELDING)	3179
Radiation Physics	3179
Radiation Protection Standards	3182
Radiation Source Calibration and Standardization	3183
Shielding Calculations and Experiments	3183
PHYSICS (THEORETICAL)	3185
General	3185
Quantum Field Theories	3187
Gravitation and General Relativity	3194
REACTOR TECHNOLOGY AND REGULATION	3197
Power Reactors, Non-Breeding, BWR-Type	3199
Power Reactors, Non-Breeding, PWR-Type	3201
Power Reactors, Non-Breeding, Graphite Moderated	3204
Power Reactors, Non-Breeding, Otherwise Moderated	3205
Power Reactors, Breeding	3206
Research, Test, and Experimental Reactors	3212
Production and Materials Testing and Processing Reactors	3215
Propulsion and Package Reactors	3215
Reactor Safety and Environmental Aspects	3216
Reactor Theory and Calculation	3222
Reactor Components and Accessories	3225
Reactor Fuels	3230
Reactor Control Systems	3231
Nuclear Power Plant Economics	3232
Reactor Fuel Cycle Economics	3234
Reactor Licensing and Regulation	3234
GENERAL AND MISCELLANEOUS	3236
Law	3236
Management	3236
Mathematics and Computers	3237
CORPORATE INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-12
SUBJECT INDEX	INDEX-91
REPORT NUMBER INDEX	INDEX-263

STAFF OF NUCLEAR SCIENCE ABSTRACTS

Editor and Production Manager
David E. Bost

Assistant Editor
Lee M. Thompson

Associate Editors
M. Catherine Grissom
Robert C. Kelly
Sidney F. Lanier
Henry D. Raleigh
Charles E. Stuber

Report Evaluators
John H. Mitchell
Mary H. Newman
Ted Redmon

Descriptive Cataloging Specialist
J. Paul Meredith

Subject Heading Specialist
Dora H. Moneyhun

Corporate Author Specialist
Clara L. Fox

Report Number Specialist
Helen W. White

Information Specialists
P. Martin Alexander
Dianna D. Altom
E. Ray Bedford
Jane G. Buchanan
D. Lamar Cason
David C. Cunningham
Theodore F. Davis
James R. Dulaney
Stanley D. Frey
Darrell O. Galde
Martha W. Gerrard
Barbara J. Glenn
Everett J. Hoffman
Carolyn D. Houston
Lynda H. Kern
W. Hugh Kinser
Lisbeth C. Lieberman
William D. Matheny
Betty L. McDowell
Lorne T. Newman
Jean F. Peckham
Mona H. Raridon
Julia S. Redford
Stanley J. Rimshaw
Jessie W. Rushing
Robert W. Rutkowski
Francis L. Sachs
Lila B. Smith
Polly C. Summers
George H. Thoeming
Helen L. Ward
Lawrence T. Whitehead
Milton O. Whitson
Martha C. Wilson

Publishing Coordinator
Charles R. Bruce

Computer Processing Coordinator
Noboru Kawakami

Composition
Composing Section

Communication concerning the editorial policy and content of *Nuclear Science Abstracts* should be addressed to the Editor, *Nuclear Science Abstracts*, USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

The Administrator of the Energy Research and Development Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.

Volume 33, Number 12 June 30, 1976

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

28272 (AEC-tr-7533/11) NUKLEONIKA. Translation of Nukleonika; 19: No. 11, 949-1042(1974). 88p. (TT-74-54003/11). Dep. NTIS $5.00.

The ten articles included are on the following subjects: alkaline regeneration of the gamma-degraded TBP–dodecane–HNO_3–H_2O system; studies on the structure of Cr(III) oxalate complexes; application of nuclear reactions in activation of Eu to preparation of Gd-153; the synthesis of 14-C-labeled triethylphosphine; application of domestic nonplasticized PVC films in chemical dosimetry; separation of Pm in the presence of Al from irradiated UO_2–Mg fuel samples; accuracy of experimental methods used in the investigations of reactor characteristics in critical assemblies with slightly enriched UO_2 fuel and light water moderator; semigroup formalism in neutron transport theory; design criteria for the determination of emergency exclusion areas around nuclear reactors in Poland; the action of x-rays on some biochemical properties of E. coli. (JGB)

28273 (NP-20848) REPORT OF THE BOSE INSTITUTE FOR 1971-72. (Bose Research Inst., Calcutta (India)). 1972. 144p. Dep. NTIS (US Sales Only) $6.00.

The work done at the Institute is centered around the following research departments and their subunits: physics (neutron physics, accelerator physics, applied radioactivity), chemistry (protein chemistry, organic chemistry, comparative phytochemistry, analytical chemistry and instrumentation), botany (mutation and plant breeding, cytogenetics, tissue culture, plant biochemistry, palynology, radiation biology), microbiology (antibiotic production, induced mutation in microorganisms, microbial genetics, molecular genetics, molecular genetics, high-yielding citric acid-producing strains of Aspergillum niger, ecology in microflora, effect of antibiotics on plant pathogens, mass culture of Rhizobium inoculam), and animal physiology (amphibian physiology, piscine physiology, insect physiology, gerontology). Although some data are given, most of the individual reports are very short. Much of the completed work can be found in appropriate journals. (RWR)

Analytical and Separations Chemistry

Refer also to abstract 29501.

28274 (EUR-5229) CATALOGUE OF REFERENCE MATERIALS OF INTEREST TO NUCLEAR ENERGY. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Dec 1974. 36p. INIS.

A provisional list of available chemical, isotopic, and trace elements reference materials of interest to nuclear energy has been established. Emphasis has been given to the substances containing uranium and plutonium. Certified values, sample sizes, prices and addresses of suppliers are indicated.

28275 (IME-TN-1/75) PRECAUTIONS ON THE STORAGE, HANDLING AND SAMPLING OF HEAVY WATER. Azuaga, N. S. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). Feb 1975. 8p. (In Portuguese). INIS.

The techniques employed by major laboratories throughout the world, for the storage and handling of heavy water and for maintenance of highly accurate standards necessary for isotopic analysis is presented. It is concluded that a separate laboratory facility and some specialized training in sample handling techniques are absolutely essential to achieve accurate isotopic analysis of heavy water.

28276 (NBL-277) ANNUAL PROGRESS REPORT, JULY 1974–JUNE 1975. (Energy Research and Development Administration, New Brunswick, N.J. (USA). New Brunswick Lab.). Feb 1976. 100p. Dep. NTIS $5.00.

The work done, primarily in various aspects of U and Pu determinations, was reported in individual reports on each project. Separate abstracts were prepared. (JSR)

For abstracts of individual papers see: 28277, 28284, 28326–28337, 28375, 28376, 28396, and 29959.

28277 (NBL-277, pp 60-61) PREPARATION OF STANDARD "UNKNOWN" SAMPLES FOR MEASUREMENT CONTROL. Goldbeck, C. G. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

A procedure is provided for the preparation of quality assurance standards for control of uranium measurements at NBL. (auth)

28278 (ORNL-5111, pp 48-56) SEPARATIONS CHEMISTRY. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Results of studies on the photochemistry of aqueous Pu solutions and the stability of iodine in liquid and gaseous CO_2 are reported. Progress is reported in studies on: the preparation of macroporous bodies filled with oxides and sulfides to be used as adsorbents; the beneficiation of photographic wastes; the anion exchange adsorption of transition elements from thiosulfate solutions; advanced filtration applications of energy significance; high-resolution separations; and, the examination of the separation agents, octylphenylphosphoric acid (OPPA) and trihexyl phosphate (THP). (JGB)

28279 (TRG-REPORT-2680(S)) ROLE OF DIFFRACTION AND ELECTRON ANALYSIS IN THE FAST REACTOR PROGRAMME. UKAEA Diffraction Analysis Conference, 22nd Meeting, Dounreay, 15-17 October 1974. Ferguson, I. F. (ed.). (UKAEA Reactor Group, Springfields). Sep 1975. 82p. (CONF-7410145-). Dep. NTIS (US Sales Only) $5.00. UK £2.00.

From 22nd UKAEA diffraction analysis conference; Dounreay, United Kingdom of Great Britain and Northern Ireland (UK) (15 Oct 1974).

After first discussing irradiation damage, the whole range of new methods of probe analysis were reviewed with special reference to the study of surfaces. Further papers discussed scanning Auger microscopy and the nuclear microprobe. Current diffraction studies were then described on uranium dioxide and the neutron poisons: boron carbide and europia. Finally new techniques were covered with special reference to the scanning electron microscope and the application of the Harwell 6000 series electronics to x-ray diffraction. Of the 17 papers and summaries, abstracts were prepared for the ten papers. (auth)

For abstracts of individual papers see: 28285, 28338, 28339, 28377, 29188, 29960, 30261, 30262, 30381, and 30382.

28280 AECL, CHALK RIVER, ONTARIO. Analytical Chemistry in Canada's Nuclear Program. Gulens, J.; Ashley, R. W. (Atomic Energy of Canada Ltd., Chalk River, Ontario). Chem. Can.; 27: No. 6, 39-41(Jun 1975).

The General Chemistry Branch provides the major analytical effort to support the research and development programs at Chalk River and to develop new analytical techniques and instruments

for the nuclear industry. Most of the analyses performed are of a non-routine nature, thereby requiring that new analytical procedures and equipment be continually developed or that existing ones be modified. The G-S heavy water process and CANDU reactor are the main concerns of the Branch. Some of the analytical work associated with the heavy water program are corrosion and effluent analysis and deuterium assay. Analysis of fuels and reactor materials, "burnup" analysis, and the testing of fuels, sheathing, and reactor system components are some of the work required for the nuclear reactor programs. (RA)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 29208, 29346, 29395, 29396, 29398, 29418, 29464, 29499, and 29925.

28281 (CEA-CONF-3143) γ AND CHARGED PARTICLE ACTIVATION ANALYSIS. Application to the Determination of C, N and O in Non-Ferrous Metals and Semiconductor Materials. Engelmann, C.; Gosset, J.; Grumet, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Recherche et Analyse). 1975. 19p. (In French). INIS.

From conference on nuclear analysis experiments; Dresden, German D. R. (12 May 1975).

The irradiation conditions, nuclear reactions and chemical separation methods used for determining C, N and O traces in metals and semiconductors are described. The results obtained are discussed: determination of C and O in alkali metals; determination of N and O in refractory metals; determination of C, N, and O in various metals and semiconductors. In certain cases, the results obtained by γ or charged particle activation analysis are compared with those obtained by other analysis methods. (FR)

28282 (GKSS-75/E/17) ISOTOPIC CONTENT DETERMINATION IN IRRADIATED FUEL BY NEUTRON TRANSMISSION ANALYSIS. Priesmeyer, H. G.; Harz, U. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1975. 5p. INIS.

From KTG-special meeting "longterm behavior"; Stuttgart, F.R. Germany (25 Feb 1975).

3 figs.; 1 tab.; 6 refs. Published in Atomkernenergie (1975), v. 25(2) p. 109-113. Available from ZAED.

Experiences and results from neutron transmission analysis of resonances in irradiated nuclear fuel for isotopic assay are reported. The measurements were made with the fast-chopper time-of-flight spectrometer of the University of Kiel at FRG-1 in Geesthacht. Samples with different U enrichments and burnups have been investigated. The absolute contents of ^{235}U, ^{238}U, ^{239}Pu, ^{131}Xe, ^{152}Sm and ^{133}Cs can be determined. High radioactivity of the samples does not affect the measurements, which in principle may be carried out nondestructively. (DE)

28283 (INIS-mf-1877) ACTIVATION ANALYSIS OF RARE EARTH IMPURITIES IN FLUORITE. Leme, D. G.; Lima, F. W.; Guenin, M. (Instituto de Energia Atomica, Sao Paulo (Brazil)). [nd]. 3p. (In Portuguese). INIS.

Activation analysis is carried out for rare earth impurities in the following fluorites obtained in Santa Catarina, Brazil: violet, yellow, green, dark blue and light blue. The method is described and experimental data given. (INIS)

28284 (NBL-277, pp 31-37) VOLUME-DEPENDENT COUNT CORRECTION FACTOR FOR THE DELAYED NEUTRON ANALYSIS OF URANIUM-235. Hagenauer, R. C.; Zyskowski, C. L.; Nelson, L. E. Jr. Feb 1976.

In annual progress report, July 1974-June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

The derivation of a volume-dependent count correction factor for the delayed neutron analysis of uranium-235 is described. (auth)

28285 (TRG-Report-2680(S), pp 18-23) ANALYSIS WITH THE NUCLEAR MICROPROBE. Pierce, T. B.; Cookson, J. A. (Atomic Energy Research Establishment, Harwell, Eng.). Sep 1975.

From 22nd UKAEA diffraction analysis conference; Dounreay, United Kingdom of Great Britain and Northern Ireland (UK) (15 Oct 1974).

In role of diffraction and electron analysis in the fast reactor programme. (UKAEA Reactor Group, Springfields).

The nuclear microprobe consists of an accelerator for producing a narrow focused ion beam, a sample holder, and detection and data processing means. Some reactions available for determining light elements are listed. Determination of C, N, and B is discussed. (DLC)

28286 EVALUATION OF RELIABILITY AND PRECISION OF DETERMINATION OF Cu CONCENTRATION BY γ-SPECTROMETRIC ACTIVATION METHOD. Bakhterev, V. V.; Sen'ko-Bulatnyj, I. N.; Kharus, R. L. (AN SSSR, Sverdlovsk. Inst. Geofiziki). Izv. Vyssh. Uchebn. Zaved., Geol. Razved.; No. 6, 138-141(1974). (In Russian)

The quantitative determination of Cu from data obtained in activation logging based on separation of the short-lived ^{66}Cu γ radiation was shown to be statistically as reliable as that from geological assay data. In the activation logging method the precision was increased by using a more stable γ spectrometer and taking into consideration the variable effect of borehole conditions. (tr-auth)

28287 QUANTITATIVE DETERMINATION OF THE HYDROGEN CONTENT IN DIFFERENT MATERIALS BY THE PROTON RECOIL METHOD. Kuritsyn, V. N.; Klochkova, L. I. Prikl. Yad. Spektrosk.; No. 5, 62-68(1975). (In Russian)

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

Recoil protons, induced by activation with a beam of 14 MeV neutrons, were measured with a counter telescope. The principles of the method are outlined and the experimental installation is described. The method could detect hydrogen at 4×10^{-3} mg with a precision of 100%. Experimental results are reported for the hydrogen content of polyethylene, NaCl, and KCl. The method can also be used to determine the concentration of T and D in the samples. (JSR)

28288 NEUTRON ACTIVATION DETERMINATION OF THE CONCENTRATION OF TRACE ELEMENTS IN MOLYBDENITE AND GALENITE. Blinov, V. A.; Gavrilov, V. M.; Zherekhov, V. G.; Egorov, Yu. S.; Krivokhatskii, A. S. Prikl. Yad. Spektrosk.; No. 5, 159-162(1975). (In Russian)

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

Spectroscopic and neutron activation analyses were made of MoS_2 and PbS samples. The sample preparation and irradiation and the measurement methods were described. Seventeen elements were determined by spectral analysis and 14 by activation analysis. Only Ag, Sb, La, and Fe were determined by both methods. The results are tabulated. (JSR)

28289 NEUTRON ACTIVATION ANALYSIS OF F, Sc, Se, Ag, AND Hf IN AEROSOLS USING SHORT-LIVED ISOTOPES. Dams, R.; Billiet, J.; Hoste, J. (Rijksuniversiteit, Ghent). Int. J. Environ. Anal. Chem.; 4: No. 2, 141-153(1975).

An 18-sec neutron irradiation of fluorine, scandium, selenium and silver produces the following short-lived isotopes: ^{20}F(11.1 s), ^{46m}Sc(18.7 s), ^{77m}Se(17.7 s), ^{110}Ag(24.6 s) and ^{179m}Hf(18.7 s). A 20-sec Ge(Li) count after a 10-sec decay period allows the simultaneous detection of these five isotopes in aerosols. Errors due to fast decay during the counting are minimized by the use of a dead-time stabilizer. The high initial counting rates due to energetic beta rays of short-lived isotopes are reduced by the use of absorbers. Fluorine is also determined, using the threshold reaction $^{19}F(n,p)^{19}O$(26.9 s). The interference due to (n, γ) reactions on other impurities in the collected aerosol is reduced by a 30-sec irradiation under cadmium-cover, and a 30-sec count after a 25-sec decay period. The activation of silver and hafnium is enhanced also by an irradiation under cadmium owing to their important resonance peaks. The technique is applied to the analysis of aerosols sampled in Belgium, at urban, industrial and background stations. (auth)

28290 NONDESTRUCTIVE NUCLEAR METHOD FOR THE DETERMINATION OF NITROGEN IN SOLIDS. Sellschop, J. P. F. (Univ. of Witwatersrand, Johannesburg); Keddy, R. J.; Mingay, D. W.; Renan, M. J.; Schuster, D. G. Int. J. Appl. Radiat. Isot.; 26: No. 11, 640-647(Nov 1975).

The nitrogen concentration in diamonds and in SiC was determined by charged particle activation analysis. The activation reaction used was ^{14}N (α, n) ^{17}F, the decay proceeding with the following characteristics: $^{17}F \rightarrow {}^{17}O + \beta^+ + \nu$ ($T_{\frac{1}{2}} = 66$ sec). The annihilation radiation was detected. Nitrogen concentrations between ~5 ppM and ~2000 ppM were found in the samples. (auth)

28291 SIMULTANEOUS DETERMINATION OF ARSENIC AND SELENIUM IN SOIL BY NEUTRON-ACTIVATION ANALYSIS. Kronborg, O. J.; Steinnes, E. (Institutt for Atomenergi, Kjeller, Norway). Analyst; 100: No. 1196, 835-837(Nov 1975).

A simple radiochemical neutron-activation method for the determination of arsenic and selenium in soils is described. After fusion of the soil with alkali and removal of the insoluble hydroxides, arsenic and selenium are determined in the solution by a simple precipitation with thioacetamide, after the solution

is acidified with hydrochloric acid. Chemical yields are determined by re-irradiation of the sulfide precipitate. The method is suitable for studies of the normal concentrations of arsenic and selenium in soils. (auth)

28292 DETERMINATION OF PERCENT CONTENT OF ^{235}U AND ^{239}Pu MIXTURE BY MEANS OF DELAYED NEUTRONS. Maksyutenko, B. P.; Balakshev, Yu. F.; Bulanenko, V. I.; Zhdanova, G. I.; Shimanskii, A. A. At. Energ. (USSR); 39: No. 6, 420-422(Dec 1975). (In Russian).

It is shown that from relative yields of delayed neutrons the percent content of a ^{235}U and ^{239}Pu mixture can be determined with an accuracy of not worse than 5% and thus differentiate between two such mixtures in which either of the components differs by 5%. The relationship of absolute yields of delayed neutrons from ^{87}Br precursor for these two nuclides also has been found. (auth)

28293 APPLICATION OF CHARGED PARTICLE ACTIVATION ANALYSIS TO SOME LIGHT ELEMENTS IN MARINE MANGANESE NODULES. Sparks, R. J.; Glasby, G. P. (New Zealand Oceanographic Inst., Wellington). N. Z. J. Sci.; 16: 643-655(1973).

Deuteron activation analysis has been applied to the determination of Na, Mg, Al, and Si in marine manganese nodules. The technique is potentially faster than atomic absorption spectrophotometry and, although less accurate, is accurate enough to show that there is marked enrichment of Al in the nucleus of the nodules, and that nodules from the South Pacific and Indian Oceans contain similar concentrations of Na, Mg, and Al. The method could be useful for analysis of light elements in other geological materials. Proton activation was attempted but was shown to be less satisfactory than deuteron activation. (auth)

28294 INTERFERENCE-FREE SUBSTOICHIOMETRIC EXTRACTION PROCEDURE FOR GENERAL APPLICATION IN NEUTRON ACTIVATION ANALYSIS. Mitchell, J. W. (Bell Labs., Murray Hill, NJ). Radiochem. Radioanal. Lett.; 24: No. 2, 123-135(30 Jan 1976).

A procedure is described in which substoichiometric separations can be performed by solvent extraction so that quantitative determinations by neutron activation are free from the influence of most chemical interferences that would normally cause an error. The extraction system, tri-n-octylphosphine oxide-cyclohexane-hydrochloric acid, in which gallium and gold are simultaneously extracted, was used as an example to demonstrate the advantages of the interference-free procedure. Traces of gold in the presence of gallium have been quantitatively determined in silicon dioxide by neutron activation and substoichiometric separation. Replicate determination of gold in the presence of different amounts of gallium was highly precise, 26.6 ± 0.3 ng. (auth)

28295 FAST ISOLATION AND DETERMINATION OF Cd IN SOME FUNGI, OTHER BIOLOGICAL MATERIALS, SOIL, AND Zn METAL BY NAA. Dermelj, M.; Ravnik, V.; Kosta, L. (Univ. of Ljubljana, Yugoslavia). Radiochem. Radioanal. Lett.; 24: No. 2, 91-101(30 Jan 1976).

A fast isolation and determination of Cd in different kinds of fungi, biological SRM-s, soil and Zn metal is described. Determination of Cd is based on a two or three stage sodium diethyldithiocarbamate extraction, depending upon the relative concentrations of other constituents. The method is simple, quantitative, and gives results of good reproducibility. (auth)

28296 MULTIELEMENT ANALYSIS OF HUMAN BLOOD SERUM BY NEUTRON ACTIVATION ANALYSIS. Nadkarni, R. A.; Morrison, G. H. (Cornell Univ., Ithaca, NY). Radiochem. Radioanal. Lett.; 24: No. 2, 103-115(30 Jan 1976).

The technique of instrumental neutron activation analysis has been used to determine up to 25 minor and trace elements in four samples of commercial and reference human blood sera. Levels of several trace elements are found to be unrealistically high in the commercial sera samples analyzed. (auth)

28297 IDENTIFICATION OF SINGLE-STRANDED COPPER WIRES BY NONDESTRUCTIVE NEUTRON ACTIVATION ANALYSIS. Chan, R.K.H. (Center of Forensic Sciences, Toronto). J. Forensic Sci.; 17: No. 1, 93-96(Jan 1972).

A method for determining quantitatively selenium, gold, antimony, and silver in parts per million levels in single-stranded copper wires by nondestructive neutron activation analysis is outlined. Its application to actual theft cases involving identification of copper wires and cables is described. Whether the copper wires are manufactured by the same or different manufacturers, the variations of trace concentrations among them have been attributed to the contamination resulting from processing, together with whatever trace variations were present in the refined bars prior to processing. These trace variations have been found to be random in nature. In the case applications, the possibility of variations along the length of wires has been considered by sampling at different points along the length of wire. There was no indication of variations for the lengths and cases in question. This possibility should, of course, always be examined in actual applications. (auth)

28298 NEUTRON ACTIVATION ANALYSIS APPLIED TO THE STUDY OF ELEMENTS ENTERING AND LEAVING A COAL-FIRED STEAM PLANT. Lyon, W. S.; Emery, J. F. (Oak Ridge National Lab., TN). Int. J. Environ. Anal. Chem.; 4: No. 2, 125-133(1975).

Neutron activation analysis (NAA) is a highly sensitive nondestructive, multi-element technique useful for analyzing samples from many sources. Following irradiation of the sample with neutrons in a nuclear reactor, induced radioactivity in the isotopes present is measured with a Ge(Li) gamma-ray spectrometer. The method has been applied to coal and ash samples from the Allen Steam Plant in Memphis, Tennessee. Twenty-nine elements have been identified, and a mass balance has been made to indicate the ultimate fate of these elements. Most are removed in either the precipitators or the bottom ash. (auth)

28299 COMPARISON OF DESTRUCTIVE AND NONDESTRUCTIVE NEUTRON ACTIVATION ANALYSIS METHODS FOR THE DETERMINATION OF TRACE IODINE IN SALIVA. Blotcky, A. J.; Hobson, D.; Rack, E. P. (Veterans Administration Hospital, Omaha). Radiochem. Radioanal. Lett.; 24: No. 4, 291-297(20 Feb 1976).

The determination of total iodine in saliva was determined by both a wet destructive procedure utilizing nitric acid–hydrogen peroxide oxidation and carbon tetrachloride solvent extraction and a nondestructive procedure utilizing both a manual Compton subtract and a computer analysis technique. From the experimental results it is concluded that the most suitable procedure is the wet chemistry destructive procedure which allows a reduction of the Compton Continuum under the iodine photopeak. (auth)

28300 DETERMINATION OF Fe AND Mn IN BAUXITE BY NEUTRON ACTIVATION ANALYSIS AND X-RAY FLUORESCENCE METHOD. Al-Mundheri, H. M.; Buczko, C. M.; Pazsit, A. (Kossuth Univ., Debrecen, Hungary). Radiochem. Radioanal. Lett.; 24: No. 4, 299-304(20 Feb 1976).

The iron content of bauxites of different origin were determined by fast neutron activation analysis and x-ray fluorescence method, using a ^{252}Cf fission neutron source in non-scattering geometry and Ge(Li) detector as well as ^{125}I exciting source and Si(Li) detector, respectively. For the determination of Mn thermal neutron activation analysis was used. The sensitivity for iron is 1.15 wt % with an absolute statistical error less than 5% in the case of fast neutron activation analysis, while for the X-ray method the sensitivity is 0.06 wt % and the absolute statistical error is 0.4%, in the case of 8 g sample weight. The sensitivity of NAA method for the determination of Mn is 0.001 wt % with an absolute statistical error of 1.7%. (auth)

28301 DETECTION LIMITS FOR 18 ELEMENTS ACTIVATED WITH 14-MeV NEUTRONS. Rurarz, E.; Pietrzykowski, M. (Inst. of Nuclear Research, Swierk, Poland). Radiochem. Radioanal. Lett.; 24: No. 4, 255-261(20 Feb 1976).

Detection limits are deduced for the following elements: Ge, Se, Br, Rb, Y, Pd, Cd, In, Sb, Ba, Ce, Nd, Sm, Er, Hf, W, Os, and Pb based on the measurements of the isomeric activities induced in the (n,2n) and (n,n') reactions at 14-MeV neutron energy. Remarkable low detection limits are observed for Rb, Ba and W. (auth)

28302 DETERMINATION OF MERCURY BY REPLACEMENT OF THALLIUM IN THALLIUM-204 LABELLED THALLIUM(I) SULFIDE. Rao, V. R. S.; Tataiah, G. (Indian Inst. of Tech., Madras). Radiochem. Radioanal. Lett.; 24: No. 4, 275-279(20 Feb 1976).

1-10 μmoles of mercury in aqueous solution may be determined by agitating the solution with thallium(I) sulfide labelled with ^{204}Tl in a centrifuge tube and counting the liquid phase. Cations giving very insoluble sulfides as silver, bismuth, antimony, iron, indium, and platinum interfere and the technique is suitable for solutions of pH 4-6. (auth)

28303 RADIOGENIC ARGON (ITS DETERMINATION BY THE NEUTRON-ACTIVATION ANALYSIS). Dubansky, A.; Podracky, P. Rozpravy Ceskoslovenske Akademie Ved. Prague; Academia (1974). 71p.

14 photographs.

The results are outlined of the application of neutron activation analysis for radiogenic argon in the absolute dating of rocks by the potassium-argon method. The instrumentation developed for the introduction of the technique is described. Neutron activation analysis is compared with other methods of determining radiogenic argon, especially in geochronological applications. (INIS)

28304 DETERMINATION OF SELENIUM IN ASTRAGALUS SP. BY NEUTRON ACTIVATION ANALYSIS. Owlya, A.; Fakhr-vaezie, F. (Teheran Univ. (Iran). Nuclear Centre). Q. Bull. Fac. Sci., Tehran Univ.; 5: No. 1, 9-12(1973). (In Iranian)

With an English abstract p. 45.

A report from veterinary faculty indicated that within 15 days more than 68 sheep were found dead by eating a plant called "Gavan" (Astragalus species). A sample of this plant was analyzed by non-destructive neutron activation analysis. Selenium has a high cross section for thermal neutrons, therefore it was irradiated, after a decay period of 30 days radionuclides with short and intermediate half-lives die out. The photopeaks of ^{75}Se with half-life of 120 days was characterized. The 0.265 and 0.280 Mev peaks of ^{75}Se were used for this determination. The result of several experiments showed the existence of 514 ± 32 ppM of selenium in the plant samples which is above the permissible dose of this element. (INIS)

28305 TRACE ELEMENT ANALYSIS IN GEOLOGICAL SAMPLES AND STUDIES IN GEOCHRONOLOGY BY NUCLEAR TECHNIQUES. Sankar Das, M. (Bhabha Atomic Research Centre, Bombay (India). Analytical Chemistry Div.). J. Geol. Soc. India; 15: No. 4, 421-428(1974).

Recent studies carried out in the Analytical Chemistry Division of the Bhabha Atomic Research Centre, Bombay, in elemental and isotopic analyses of samples of geological importance by the neutron activation methods are reviewed. The technique is quite specific and sensitive down to 0.1 ppM of uranium. Another technique of interest to geologists is the fission track counting method. In the field of geochronology, the uranium, and thorium contents of zircons have been determined by the neutron activation method and the lead content by anodic stripping voltametry. These measurements have permitted the determination of the Th/U ratios and the chemical ages of zircons. The limitations of the technique are the same as apply to the Pb-α method. Using the neutron activation method, the isotopic analysis of Pb-204 and Pb-208 has been carried out and the data has permitted the dating of thorium minerals. Model ages of galenas have been determined using the data obtained. The limitation of techniques and the interpretation of the ages have been critically commented upon. (auth)

28306 CONCENTRATION OF SOME ELEMENTS IN STANDARD MATERIALS. Donev, I. I.; Marichkova, L. M. (Inst. of Nuclear Research and Nuclear Energy, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 9, 1179-1182(1975). (In Russian).

Neutron activation analyses were made of the standard solution RSM-1577 containing trace amounts of K, Na, Fe, Zn, Cu, Br, Mn, and Cr and compared with NBS measurements and those of other investigations. The application of neutron activation to the determination of these elements in biological samples was also tested and proved to be valid. (JSR)

28307 TRACE ELEMENTS IN ANCIENT SILVER COINS BY NEUTRON ACTIVATION AND SOLVENT EXTRACTION WITH BISMUTH DIETHYLDITHIOCARBAMATE. Schubiger, P. A.; Mueller, O. (Max-Planck Institut fuer Kernphysik, Heidelberg). Radiochem. Radioanal. Lett.; 24: No. 5-6, 353-361(4 Mar 1976).

A procedure for trace element analyses in ancient Greek silver coins using radiochemical neutron activation and solvent extraction technique is reported. Extraction with bismuth diethyldithiocarbamate as reagent has been applied to a multi-ionic system, namely chemical solutions of silver coins. In one separation step, the major and minor elements Ag, Cu and Au are extracted to a high degree into the organic phase, whereas the trace elements Na, Mn, Co, Ni, As, Sn, Sb and Ir remain in the aqueous phase. The activities of these elements are counted on a Ge(Li) well detector and compared to those of a standard sample. Chemical yields are determined by post-activation. (auth)

28308 DETERMINATION OF MERCURY IN HUMAN TISSUES AFTER ACUTE POISONING BY NEUTRON ACTIVATION. Rakovic, M. (Karlova Univ., Prague); Glagolicova, A.; Prouza, Z.; Gregora, Z. Radiochem. Radioanal. Lett.; 24: No. 5-6, 317-321 (4 Mar 1976).

The nondestructive determination of mercury in human tissues after acute poisoning based on the use of γ-ray spectrometer with a Ge(Li) semiconductor detector is described. (auth)

28309 COMPARISON BETWEEN TWO METHODS OF QUANTITATIVE DETERMINATION OF FLUORINE. Deconninck, G.; Stroobants, J.; Stone, W. E. E.; Charlier, H. (Facultes Univ., Namur, Belgium). Radiochem. Radioanal. Lett.; 24: No. 5-6, 331-340(4 Mar 1976).

A comparison is made between two methods of determination of fluorine: prompt γ-ray analysis and spectrophotometrical determination. Both techniques are applied for the quantitative analysis of fluorine in glasses and micas. The results are compared and a statistical analysis is presented: a good agreement is observed. The two techniques are found to be of comparable accuracy and sensitivity, each having its own advantages. (auth)

28310 EXPERIENCE GAINED ON THE USE OF NEUTRON-ACTIVATED TIN FOR LABELLING PURPOSES WITH PRODUCTION OF COMPOUND SEMICONDUCTORS. Schulz, U.; Geidel, B., Buhrig, E. Isotopenpraxis; 11: No. 11, 399-404(1975).

The knowledge of the Sn content in monoatomic crystals, which is necessary for the estimation of $ZnSiP_2$ crystals grown in solutions containing Sn, demands a highly sensitive analyzing technique. The use of the isotopic mixture arising with neutron activation of natural tin renders necessary the separate detection of ^{113}Sn, in addition to Sb and Te isotopes. By means of the described spectrometric method providing simultaneous detection of tin, antimony and tellurium, both the tin content of $ZnSiP_2$ crystals grown in solutions and the distribution coefficients of Sn, Sb and Te affecting crystallization are determined. Furthermore, the clean-up effect of various techniques of etching Zn, Si or $ZnSiP_2$ using this isotope mixture as an indicator was checked. (auth)

28311 USE OF THE REACTION $^{10}B(n,\alpha)$ FOR THE DETERMINATION OF THE DISTRIBUTION OF BORON ATOMS IN SILICON. Boganch, Ya.; Dyulai, I.; Nad, A.; Nazarov, V. M.; Shereshch, Z.; Yavitskii, Yu. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Isotopenpraxis; 11: No. 12, 429-432(1975). (In Russian).

Measurements made on the pulse reactor IBR-30 showed that by use of the time-of-flight method the average value of the projection R_p of the actual mean free path of B could be determined using a thermal neutron flux of 10^8 n/cm²sec on samples with ^{10}B concentrations of 10^{15} atom/cm². The precision of the determination of R_p is principally limited by the resolution of the detector used. At the limit of ±200 Å the values obtained agree well with the theoretical values of the mean free path calculated by the LSS theory. (tr-auth)

28312 MULTIELEMENT CHARGED PARTICLE ACTIVATION ANALYSIS WITH X-RAY COUNTING. McGinley, J. R.; Schweikert, E. A. (Texas A and M Univ., College Station). Anal. Chem.; 48: No. 2, 429-435(Feb 1976).

Energy dispersive x-ray counting of radioactive species produced by charged particle activation was studied as a nondestructive multielement trace analysis method for elements of Z greater than or equal to 26. Experimentally determined thick target yields and interference-free detection limits are presented for proton and deuteron activation products of 37 elements. These detection limits range from 1×10^{-4} microgram for Mo to 3.4 microgram for Rh for a 6 microamphere-hour irradiation with 20 MeV protons. The application of this technique is illustrated with data on the simultaneous determination of up to 26 elements in NBS standard glass samples at the 500-, 50- and 1-ppM levels using 20-MeV proton activation. (auth)

28313 INSTRUMENTAL ACTIVATION ANALYSIS OF GOLD IN ORES AND THEIR ENRICHMENT PRODUCTS BY USING LINEAR ELECTRON ACCELERATOR. Abbosov, A.; Abrams, I. A.; Kodiri, S.; Pelekis, L. L.; Starchik, L. P. pp 94-97 of Activation Analysis in National Economy. Tashkent; Fan (1974). (In Russian)

A presentation is given of two techniques of determining gold in ores and concentrates by neutron-γ activation analysis. The threshold sensitivity of both methods is 1×10^{-4}% at an electron energy of 5 Mev and a current of 0.7 ma.

28314 ON NEUTRON ACTIVATION DETERMINATION OF SILICON USING NEUTRON BEAM FROM NUCLEAR REACTOR. Akbarov, U.; Allabergenov, B.; Uzakova, U.; Umirbekov, K.; Yankovskij, A. V. pp 86-87 of Activation Analysis in National Economy. Tashkent; Fan (1974). (In Russian)

A technique is described for determining Si by activation analysis according to the reaction $^{28}Si(n,p)^{28}Al$. Irradiation of the samples and standards is carried out in the horizontal channel of a nuclear reactor having a flux of $\sim 10^8$ neutrons/cm² · sec. In order to suppress disturbances from Al because of the reaction $^{27}Al(n,\gamma)^{28}Al$, use is made of a combination filter consisting of metallic Cd and a layer of H_3BO_3. The ^{28}Al activity is measured from its 1.78 Mev γ radiation. Under these conditions at a content of ~20% Al_2O_3 and ~30% SiO_2 the error introduced by Al does not exceed 2%. The analysis of a prepared sample can be completed in less than 5 minutes.

28315 NEUTRON ACTIVATION STUDY OF MICROELEMENTAL COMPOSITION OF OILS. Berkutova, I. D.; V'yunkova, E. S.; Zhaluina, T. I.; Zlotova, I. M.; Yakubson, K. I. pp 68-73 of Activation Analysis in National Economy. Tashkent; Fan (1974). (In Russian)

A technique was developed for the nondestructive neutron-activation determination of Na, Cu, Mn, Br, As, and Co in oil, distillation products, coke residues, resins, asphalts, and bitumens. A liquid sample (0.2 to 1.0 g), coke samples (0.2 to 0.5 g) or a bitumen sample (10 to 20 mg) were sealed in quartz ampules, and irradiated less than one hour (in analyzing coke <5 hrs, bitumen 10 to 30 minutes and a number of hours) in a nuclear reactor channel at a neutron flux of 1.3×10^{13} neutrons/cm^2/sec. Gamma spectra of the irradiated samples were taken 4 to 5 hours (in analyzing bitumens, again, 15 to 20 days) after the irradiation, and the spectra were processed on an M-20 computer by use of the program MNK-512. A study was carried out of the distribution of microelements in separate fractions of oils, and of regularities in the composition of oils from various regions of the USSR.

28316 APPLICATION OF NEUTRON ACTIVATION ANALYSIS WITH SEMICONDUCTOR SPECTROMETRY IN THE CONTROL OF OIL FIELD EXPLOITATION. Blankova, T. N.; Bochkarev, B. N.; Kiselev, B. G.; Korzhenewskaya, N. I.; Nagaev, M. G.; Yusupov, M. Z. pp 73-75 of Activation Analysis in National Economy. Tashkent; Fan (1974). (In Russian)

A method is described for the analysis of oil and water. The ratio Br/Na is taken as a criterion of water saturation of strata. It is proposed that information on the composition of oils be used in order to identify oils of various strata levels and to estimate their mobilities.

28317 PROBLEMS OF THEORY AND INTERPRETATION OF NUCLEAR PHYSICAL ELEMENTAL ANALYSIS. Boyarkin, A. P.; Kainov, R. L. (AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). pp 3-50 of Nuclear Physical Methods for Analysis and Control of Technological Processes. Tashkent; Fan (1974). (In Russian)

Consideration is given to problems in the theory of determining the tungsten content of slurries by γ absorptiometry, and a technique is developed for interpreting a γ fluorescence analysis. A presentation is given of mathematical equations for interpreting radiation capture spectrograms, and of a technique of interpreting the results of radiation spectrometry of Hg in boreholes.

28318 ON THE POSSIBILITY OF CREATING A SYSTEM FOR EXPRESS PHOTOACTIVATION METHOD FOR GOLD DETERMINATION IN ORE POWDER SAMPLES. Burmistenko, Yu. N.; Gambaryan, R. G.; Feoktistov, Yu. V. pp 92-94 of Activation Analysis in National Economy. Tashkent; Fan (1974). (In Russian)

Consideration is given to techniques of determining gold by photoactivation, and to the equipment requirements in the case of ore analysis. It is shown that it is desirable to automate the photoactivation determination of gold in ores. (tr-SJR)

28319 ACTIVATION DETERMINATION OF SELENIUM IN SEDIMENTARY ROCKS. Dutov, A. G.; Kaipov, R. L.; Kobelev, L. N.; Leushkina, G. V. pp 61-62 of Activation Analysis in National Economy. Tashkent; Fan (1974). (In Russian)

A description is given for determining Se from the induced activity of the isotope ^{77m}Se in sandstones with the use of two neutron sources: a reactor and a Po-Be source. Samples of ~100 mg were sealed in a polyethylene capsule and after neutron irradiation (5 seconds in a reactor, and 55 secs in the Po-Be source) the samples were delivered through pneumatic tubes to a γ spectrometer. The intensity of the 160 kev photopeak of ^{77m}Se was measured after 17 sec., and then 1.5 min later the background of the sample was measured and subtracted from the previous spectrum. The activity was calculated from the photopeak area in the difference spectrum which was obtained. The measuring unit includes a scintillation γ spectrometer for total absorption (80 × 80 NaI(Tl) crystal with a well), pulse analyzer AI-128, and a pneumatic tube system. The error of determining Se in the samples is ~20 to 30% with an error of counting the activity in the region of ^{77m}Se of less than 1.5%. The sensitivity improves on analyzing samples having a lower natural radioactivity. (tr-SJR)

28320 APPLICATION OF NEUTRON GENERATORS FOR PRECISE ANALYSIS OF STANDARD ROCKS FOR Al AND Si CONCENTRATIONS. Kasatkin, V. A.; Lejpunskaya, D. I.; Chulanov, Yu. G. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Yadernoj Geofiziki i Geokhimii, Moscow (USSR)). pp 82-83 of Activation Analysis in National Economy. Tashkent; Fan (1974). (In Russian)

The content of Al (from ^{27}Mg) and Si (from ^{28}Al) was determined with the use of neutron generator NG-160 (whose output was maintained at a level of 10^9 neutrons/sec), a single-crystal scintillation γ spectrometer, and a two-channel differential analyzing unit. Analyses were carried out on powder samples 10 to 12 grams in weight, which are placed in plexiglass cassettes. Standard samples of metallic aluminum and quartz are irradiated at the same time with the unknown sample, and measurements of the induced activities are used to monitor the neutron flux and to cut off automatically the equipment drift. Measurements of the γ radiation were carried out in two energy intervals of 0.75-0.95 MeV (Al and Si) and 1.65-1.95 MeV (Si). The time parameters of the analysis were selected for optimum determination of Si. The time program of the analysis was automatically assigned by an electronic timer unit. The standard samples were made from metallic Si of semiconductor purity, metallic Al of AV-000 grade, optical quartz and chemical-pure Al_2O_3. The content of Al and Si was determined with the interference being taken into account because of activation of phosphorous from the reaction ^{31}P(n,α)^{28}Al and activation of iron from the reaction ^{56}Fe(n,p)^{56}Mn. The magnitude of the corrections which are introduced depending on the type of ore to be analyzed was 0.36-0.71% for SiO_2 and 0.24-1.36% for Al_2O_3. (tr-SJR)

28321 TABULATION OF CALCULATED DATA ON PRIMARY REACTION INTERFERENCES IN 14-MeV NEUTRON ACTIVATION ANALYSIS. Krivan, V.; Krivan, K. (Max-Planck-Institut fuer Metallforschung, Stuttgart). J. Radioanal. Chem.; 29: No. 1, 145-173(1976).

This table enables a quick estimate of the primary reaction interferences which can occur in 14-MeV neutron activation analysis for all determinable elements throughout the periodic system. Published experimental cross sections, and cross sections estimated by semiempirical formulae and systematics were used to calculate the ratio of the radioactivity produced from the element to be determined via the principal reaction and of the radioactivity produced via the primary interference reaction for three energy intervals between 14 MeV and 15 MeV. Also listed are the used cross section data and abundances of the appropriate isotopes for both the element to be determined and the interfering element, as well as the half-lives of the indicator radionuclides. (auth)

28322 USE OF THRESHOLD ENERGY DIFFERENCES IN FAST NEUTRON ACTIVATION ANALYSIS FOR OXYGEN AND FLUORINE. Bibby, D. M.; Guinn, V. P. (Univ. of the Witwatersrand, Johannesburg). J. Radioanal. Chem.; 29: No. 1, 121-127 (1976).

A method is described for the simultaneous determination of oxygen and fluorine; the latter has a lower neutron-activation threshold energy so that the fluorine-to-oxygen ^{19}N formation ratio changes after partial moderation of the incident 14.7 MeV neutron beam. In mixtures containing approximately equal amounts of fluorine and oxygen, these elements can each be determined with a precision of ca. ±1%; as expected, errors in the determination of a minor component (ca. 17%) are larger, being ca. ±5%. (auth)

28323 MULTI-ELEMENT ANALYSIS OF BIOLOGICAL SAMPLES AFTER INTENSE NEUTRON IRRADIATION AND FAST CHEMICAL SEPARATION. Gaudry, A.; Maziere, B.; Comar, D. (CEN de Saclay, Gif-sur-Yvette, France). J. Radioanal. Chem.; 29: No. 1, 77-87(1976).

For the simultaneous determination of many elements in small biological samples, a multi-element analysis has been developed using neutron activation. After a 24-hr irradiation in a neutron flux of $2.5 \cdot 10^{14}$ n·cm^{-2}·sec^{-1} and after immediate chemical separation without cooling, it was possible to analyze 24 elements in bovine liver (NBS-SRM 1577). The separation apparatus set up in a shielded cell can work four samples simultaneously, and its operation is fast enough to allow the detection of radioisotopes with a half-life of about 2 hrs (^{165}Dy, ^{87m}Sr, ^{56}Mn). Amounts lower than 10^{-3} μg of Dy, Eu, Pr, Sm and Yb were determined. (auth)

28324 GEOCHEMICAL PROFILE OF CHAUTAUQUA LAKE SEDIMENTS. Hopke, P. K. (State Univ. Coll., Fredonia, NY); Ruppert, D. F.; Clute, P. R.; Metzger, W. J.; Crowley, D. J. J. Radioanal. Chem.; 29: No. 1, 39-59(1976).

Neutron activation analysis techniques were used to study sediments from Chautauqua Lake. The concentrations of Eu, Na, Mn, K, Br, As, Ga, La, Hf, Cs, Tb, Sc, Fe, Ta, and Sb were determined and compared with similar data for the bedrock and soils surrounding the lake. The lake sediments are found to be enriched in Na, Mn, Br, As, Hf, Tb, Ta, and Sb relative to the surrounding source beds. High pairwise linear correlation coefficients (R ~ 0.9) were found between the concentrations of antimony, cesium, and scandium. For many elements a relationship was indicated between their concentrations and the clay fraction of the sediment, possibly due to the higher cation exchange potential of the clay minerals. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 28648 and 29084.

28325 (CCEN-37) CONTENT OF MICROELEMENTS IN THE PRINCIPAL FERTILIZERS SOLD IN THE NORTHEAST BRAZIL. Duarte, P. J.; Horowitz, A.; Silva, M. O. M. da; Godoy, M. O. (Pernambuco Univ., Recife (Brazil). Centro de Energia Nuclear). Jul 1974. 20p. (In Portuguese). INIS.

The content of microelements in fertilizers sold in Recife was determined in extracts obtained in hot demineralized water and in boiling 3N hydrocloric acid. The contents of copper, zinc, cobalt and manganese were determined by atomic absorption while those of boron and molybdenum were obtained by optical spectrophotometry. In this work the results obtained show that for certain elements (zinc, boron, manganese and molybdenum) the existing amounts are significant and should be taken into account. (INIS)

28326 (NBL-277, pp 4-6) EFFECT OF IMPURITIES ON THE NBL TITRIMETRIC METHOD OF DETERMINING URANIUM. Bodnar, L. Z. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

The last of a series of reports on the effect of impurities on the titrimetric determination is presented. Twenty-three additional elements were investigated; none produced significant interference effects. (auth)

28327 (NBL-277, pp 12-13) EFFECT OF HIGH ALPHA ACTIVITY ON THE NEW BRUNSWICK LABORATORY TITRIMETRIC METHOD OF DETERMINING URANIUM: A JOINT EFFORT WITH OAK RIDGE NATIONAL LABORATORY. Bodnar, L. Z. (New Brunswick Lab., NJ); Layton, F. L. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick, N. J. (USA). New Brunswick Lab.).

HTGR recycle fuel may contain significant quantities of U-232. The effect of high density alpha activity on the NBL titrimetric method of determining uranium was investigated. (auth)

28328 (NBL-277, pp 14-19) DETERMINATION OF URANIUM IN FISSION-URANIUM ALLOY AND IN FISSIUM DROSS. Bodnar, L. Z. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

Dissolution and analysis techniques for fissium-uranium alloy and fissium dross are described. The fuming technique of dissolution effectively eliminated all interferring elements in the titration determination of U. The results from the semiquantitative analysis of fission dross by spark source mass spectrometry were tabulated. (JSR)

28329 (NBL-277, pp 20-22) DETERMINATION OF URANIUM FOLLOWING REDUCTION WITH IRON(II) IN PHOSPHORIC ACID UTILIZING AMPEROMETRIC END-POINT DETECTION. Lewis, K. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

A procedure for the determination of 1 to 5-mg quantities of uranium which combines potentiometry and amperometry is described. Results are free of bias with coefficients of variation of less than 0.1 percent. (auth)

28330 (NBL-277, pp 26-28) DETERMINATION OF URANIUM IN SCRAP MATERIALS BY ISOTOPE DILUTION MASS SPECTROMETRY. Wenzel, A. W.; Weiss, J. R.; Connolly, V. E.; Callis, E. L.; Pietri, C. E. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

A procedure is described for the determination of uranium in calcined ash samples by isotope dilution mass spectrometry. (auth)

28331 (NBL-277, pp 38-45) EVALUATION OF THE NEW BRUNSWICK LABORATORY 12" 60^0 MASS SPECTROMETER USING A NATIONAL BUREAU OF STANDARDS STYLE SYSTEM CALIBRATION. Connolly, V. E.; Callis, E. L.; Summers, A. W. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

A study to demonstrate the performance capabilities of NBL mass spectrometer instrumentation using a National Bureau of Standards calibration procedure is discussed. (auth)

28332 (NBL-277, pp 64-66) COLORIMETRIC DETERMINATION OF IRON IN URANIUM OXIDE WITH FERROZINE. Trahey, N. M. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

A simple but effective procedure for the determination of iron in the presence of uranium with ferrozine is described. (auth)

28333 (NBL-277, pp 68-70) DETERMINATION OF MAGNESIUM IN BERYLLIUM BY ATOMIC ABSORPTION SPECTROMETER. Graff, R. L.; Yuster, H. G. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

A procedure is described for the determination of magnesium in beryllium by atomic absorption spectrophotometry which eliminates the hazards associated with the aspiration of beryllium into the burner of the instrument. (auth)

28334 (NBL-277, pp 71-79) INVESTIGATION OF THE LONG-TERM RELIABILITY AND REPRODUCIBILITY OF A CONTROLLED-POTENTIAL COULOMETRIC METHOD PROPOSED FOR THE DETERMINATION OF PLUTONIUM. Greer, R. J.; Peoples, G. E.; Malone, S. A.; Weiss, J. R.; Wenzel, A. W.; Pietri, C. E. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

Work is described in which experiements with iron were performed to assess the long-term reliability and reproducibility of coulometric measurements. Procedures are included for instrument calibration and electrode conditioning. (auth)

28335 (NBL-277, pp 80-85) PRELIMINARY EVALUATION OF AN AUTOMATED COULOMETRY SYSTEM (AUTOCOULOMETRY) FOR PLUTONIUM. Peoples, G. E.; Malone, S. A.; Weiss, J. R.; Wenzel, A. W.; Pietri, C. E. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

The testing of the mechanical and electrical performance of the NBL autocoulometry system for Pu assay is described. (auth)

28336 (NBL-277, pp 86-88) RESPONSE OF GOLD ELECTRODES FOR USE IN CONTROLLED-POTENTIAL COULOMETRY. Malone, S. A.; Greer, R. J.; Peoples, G. E. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

The operating characteristics of three hand-crafted gold working electrodes were evaluated for use in controlled-potential coulometry.

28337 (NBL-277, pp 89-92) EFFECT OF ION EXCHANGE SEPARATION PROCEDURES ON CONTROLLED-POTENTIAL COULOMETRIC ANALYSIS. Greer, R. J.; Pietri, C. E.; Weiss, J. R.; Wenzel, A. W. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

A systematic study of the effect of ion-exchange separation procedures on the controlled-potential coulometric determination of plutonium is described. (auth)

28338 (TRG-Report-2680(S), pp 27-30) STUDY OF RADIOACTIVE MATERIALS IN SCANNING ELECTRON MICROSCOPES. Adam, J.; Bainbridge, J. E. (Atomic Energy Research Establishment, Harwell, Eng.). Sep 1975.

From 22nd UKAEA diffraction analysis conference; Dounreay, United Kingdom of Great Britain and Northern Ireland (UK) (15 Oct 1974).

In role of diffraction and electron analysis in the fast reactor programme. (UKAEA Reactor Group, Springfields).

Operational problems are encountered in the use of SEM to examine radioactive materials. Specimen size, shielding, and containment are discussed. X-ray spectra of Cr, Mn, and V are shown for an irradiated steel. (DLC)

28339 (TRG-Report-2680(S), pp 30-35) APPLICATIONS AND DESIGN OF A BACKSCATTERED ELECTRON DETECTOR FOR USE IN AN SEM. Smith, B. J.; Marshall, D. C. (Atomic Energy Research Establishment, Harwell, Eng.). Sep 1975.

From 22nd UKAEA diffraction analysis conference; Dounreay, United Kingdom of Great Britain and Northern Ireland (UK) (15 Oct 1974).

In role of diffraction and electron analysis in the fast reactor programme. (UKAEA Reactor Group, Springfields).

This paper describes a backscattered electron detector developed for use in a scanning electron microscope. Applications of the method of detection are discussed and examples of the three principal uses are shown. These are in the display of atomic number variations, examination of crystal quality and in the topographical examination of insulating specimens. (auth)

28340 REPRODUCTION OF THE RAD UNIT IN THE LONG-WAVE X-RAY RADIATION RANGE BY MEANS OF A LIQUID IONIZATION CHAMBER. Frolova, A. V.; Kolotilova, V. G. Meas. Tech. (USSR) (Engl. Transl.); 18: No. 7, 1084-1086(Jul 1975).

Translated from Izmer. Tekh.; 18: No. 7, 82-83(Jul 1975).

The operation and performance of a liquid ionization chamber for absolute measurement of x-ray absorbed dose are described. (WHK)

28341 Mo(III) DETERMINATION IN THE PRESENCE OF Mo(V) IN CHLORIDE ALKALINE MELTS. Tserkovnitskaya, I. A.; Zhilina, T. I. Vestn. Leningr. Univ., Fiz., Khim.; No. 3, 113-117(Aug 1975). (In Russian).

Conditions of ox-red Mo(III) reaction with methylene blue by spectrophotometric method was studied. The possibility of amperometric titration of Mo(III) with methylene blue was shown. Mo(V) quantities which allow Mo(III) to be determined by amperometric and spectrophotometric methods were established. (auth)

28342 DETERMINATION OF MOLYBDENUM IN FERRO-MOLYBDENUM AND IN HIGHLY ALLOYED ALLOYS BY A DIFFERENTIAL SPECTROPHOTOMETRIC METHOD. Rybina, T. F. (Central Scientific Research Inst. of Ferrous Metallurgy, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 7, 1006-1007(Jul 1975).

Translated from Zavod. Lab.; 41: No. 7, 797-798(Jul 1975).

A method is described for the spectrophotometric determination of Mo with sulfonitrazo E in ferromolybdenum and alloys containing Cr, Mn, Ni, Ti, and Al. The absorbance is measured at 565nm using either a differential or absolute method. A 500-fold excess of Ni, Cr, Co, and Mn does not form colored complex compounds with the reagent and does not interfere. Ascorbic acid is used to mask the interference of Fe^{3+}. (BLM)

28343 GRAVIMETRIC DETERMINATION OF Gd(III) WITH N-m-TOLYL-m-NITROBENZOHYDROXAMIC ACID. Kapoor, H. L. (Maulana Azad Coll. of Tech., Bhopal, India); Agarwal, Y. K. Indian J. Chem.; 13: No. 9, 975-976(Sep 1975).

The gravimetric determination of Gd(III) in the presence of various diverse ions including several rare earths involves precipitation with N-m-tolyl-m-nitrobenzohydroxamic acid at pH 10.3-10.5. The complex having the composition $(C_{14}H_{11}N_2O_4)_3Gd$ is weighed directly after drying at 110°. (auth)

28344 DETERMINATION OF ZIRCONIUM IN THE PREPARATION OF TITANIUM–ZIRCONIUM ALLOYS. Dolgorev, A. V.; Pal'nikova, T. I. (State Inst. of Mining Chemical Raw Materials, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 7, 1008-1010 (Jul 1975).

Translated from Zavod. Lab.; 41: No. 7, 798-810(Jul 1975).

A spectrophotometric method is described for the determination of 0.005-5% Zr in $TiCl_4$ melts and 0.2-40% Zr in Ti alloys using gallocyanine MS reagent. The method is also applicable to the determination of Zr in $ZrOCl_2$ and in by-products from the manufacture of Ti alloys. Hydroxylamine was used to mask the interfering elements, and the absorbance of the complex was measured at 610 nm. The determination of Zr with gallocyanine MS was compared with determinations using picramine and arsenazo III. The methods were compared as to range of working conditions, stability of the complex, and selectivity; and gallocyanine was selected as the superior reagent. (BLM)

28345 CHARACTERIZATION OF ISOTHIOCYANATO NIOBATES(V) ISOLATED FROM SOLUTIONS FOR THE SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM. Tamhina, B.; Djordjevic, C. (Univ. of Zagreb). Croat. Chem. Acta; 47: No. 2, 79-85(1975).

From aqueous solutions containing niobium(V), sulfuric acid and an excess of thiocyanate, under the conditions for the spectrophotometric determination of niobium, the compounds $[(C_6H_5)_4P]_2$ $[NbO(NCS)_5]$, $[(C_6H_5)_4As]_2$ $[NbO(NCS)_5]$ and $[(C_2H_5)_4N]_2$ $[NbO(NCS)_5]$ were isolated either by crystallization or by extraction with diethyl ether and evaporation of the extracts. $(C_2H_2N_2S_3)_2H[Nb(NCS)_6]$ was isolated from an ether extract only. The compounds have been characterized by analytical data, infrared spectra, magnetic and conductivity measurements. In all the compounds the thiocyanate groups bond through the nitrogen atom. (auth)

28346 DETERMINATION OF OXYGEN, NITROGEN, AND HYDROGEN IN REFRACTORY METALS AND ALLOYS. Mikhailichenko, L. I.; Markov, V. K.; Kossykh, V. G. Ind. Lab. (USSR) (Engl. Transl.); 41: No. 7, 973-976(Jul 1975).

Translated from Zavod. Lab.; 41: No. 7, 769-773(Jul 1975).

A procedure and apparatus are described for the determination of H_2, O_2, and N_2 in metals by reduction-fusion in a He or Ar gas stream and chromatographic determination of the individual gases. The active volume of the apparatus described is 1.5 cm^3, and all operations of the procedure are automated except replacement of the sample capsule. The results of determinations of H_2, O_2, and N_2 in Mo, W, and steels reported at the 95% confidence level are tabulated. The sensitivity of the method for an average sample of 200 mg is 0.002 wt % O_2 and 0.0002 wt % N_2 and H_2. (BLM)

28347 UTILIZATION OF ORGANIC REAGENTS IN THE VOLUMETRIC DETERMINATION OF MICROQUANTITIES OF IODINE. Gantchev, N.; Kireva, A. (Inst. of Industrial Chemistry, Sofia). Mikrochim. Acta; 2: No. 6, 627-632(1975). (In French).

A method has been developed for the titrimetric determination of microquantities of iodine by means of the organic reagents: Chrompyrazol I and Methylene blue. The recommended method is based on the combination of the extractional and volumetric methods and permits the titration of as little as 1 μg of I^-/ml. The determination is not impaired by the ions: Br^-, Cl^-, NO_3^- and SO_4^{2-}. (auth)

28348 INDIRECT HIGHLY SELECTIVE MICRODETERMINATION OF ALUMINUM AND BERYLLIUM BY THE WEISZ RING OVEN. Johri, K. N.; Handa, A. C. (Univ., Delhi). Mikrochim. Acta; 2: No. 6, 683-688(1975).

The proposed method deals with an indirect procedure of determining aluminium(III) and beryllium(II) ions by means of calcium ions which are released from the insoluble calcium fluoride under certain specified conditions. Calcium ions thus liberated are determined by the Weisz ring oven technique employing glyoxal bis(o-hydroxyanil). The determination has been made selective by fixing the released calcium ions as carbonate in the ammoniacal medium, and washing the various foreign ions out of the filter paper. 0.7 μg of aluminium ions and 0.3 μg of beryllium ions can be determined within ±5% error.

28349 SIMULTANEOUS DETERMINATION OF OXYGEN AND NITROGEN IN METALS BY ISOTOPE DILUTION METHOD. Vitol, E. N.; Orlova, K. B. Ind. Lab. (USSR) (Engl. Transl.); 41: No. 4, 536-539(Apr 1975).

Translated from Zavod. Lab.; 41: No. 4, 437-439(Apr 1975).

Isotope dilution was used to study the mass spectrometric simultaneous determination of N_2 and O_2 in metals even for cases of very similar masses as with $^{12}C^{18}O$ and $^{15}N_2$. A computational formula was derived, and samples of N and CO containing known amounts of ^{15}N and ^{18}O were analyzed by mass spectrometry. To check the method, an isotope exchange was performed at 1500–1600°C for 5 min, then the CO and N^2 gas was separated using the CaA Zeolite. The mass spectra of the separated gas was analyzed to determine the isotopic concentration of N_2 and O_2 in the metal sample. A comparison of O_2 values calculated from the computational formula and of O_2 values determined in separated gas showed good agreement. (DDA)

28350 X-RAY SPECTROSCOPIC DETERMINATION OF HIGH CONCENTRATIONS OF TANTALUM AND NIOBIUM. Sidorovskii, A. I.; Berkovits, L. A.; Grigor'ev, V. A.; Lontsikh, S. V. (All-Union Scientific Research Inst. of Physicotechnical and Radio Technical Measurements, Irkutsk, USSR). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 4, 524-527(Apr 1975).

Translated from Zavod. Lab.; 41: No. 4, 428-431(Apr 1975).

A method was needed to determine Nb and Ta concentration in samples of rocks, rare earth ores, and concentrates to an accuracy of ±0.3% in the concentration range of 20–50%. A technique was proposed where x-ray spectrographic analysis was performed on successive dilutions of the sample made with a filler of known concentration. The quadratic model $C = a_0 + a, I + a_2I^2$ was used to calculate the concentration, C; where a is an unknown coefficient, and I is the intensity of analyzed element radiation. The coefficient, a, was calculated by least squares method. (DDA)

28351 EXTRACTION–PHOTOMETRIC DETERMINATION OF CERIUM IN ALLOYED STEELS. Iordanov, N.; Mareva, S.; Ivanova, E. (Inst. of General and Inorganic Chemistry, Sofia). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 4, 489-490(Apr 1975).

Translated from Zavod. Lab.; 41: No. 4, 403(Apr 1975).

Low concentrations of cerium in steel samples were determined photometrically using the reaction of Ce(IV) with the organic reagent, tetramethyl-o-tolidine (tetrone). Because Au(III), Mn(VII), V(V) and large quantities of iron interfere with the photometric analysis, cerium was isolated by extraction with methyl isobutyl ketone from strong HNO_3 in the presence of sodium borate and then reextracted with H_2O_2. For conversion to the tetravalent form, a

HNO_3 solution of Ce was precipitated with oxalic acid and calcined at 900°C. The oxides were redissolved in H_2SO_4, the color was developed with tetrone and analyzed photometrically at 470 nm. The color intensity is stable for 30 min. (DDA)

28352 INVESTIGATION OF THE CONDITIONS OF EXTRACTION–PHOTOMETRIC DETERMINATION OF LUTETIUM IN THE PRESENCE OF LANTHANUM. Mishchenko, V. T.; Tselik, E. I.; Koev, A. P.; Poluektov, N. S. (Inst. of General and Inorganic Chemistry, Odessa). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 5, 641-642(May 1975).

Translated from Zavod. Lab.; 41: No. 5, 521-523(May 1975).

Lutetium was complexed with 5,7-diiodo-8-hydroxyquinoline and the complex was extracted with chloroform. The amount of lutetium determinable in the presence of lanthanum is 0.5–5.0%. (LF)

28353 INVESTIGATION OF THE CONDITIONS OF SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(VI) WITH BROMOPYROGALLIC RED AND CETYLTRIMETHYLAMMONIUM BROMIDE. Kirillov, A. I.; Golentovskaya, I. P.; Vlasov, N. A. (Irkutsk State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 5, 643-644(May 1975).

Translated from Zavod. Lab.; 41: No. 5, 523-525(May 1975).

Results of an investigation of the reaction of the uranyl ion with bromopyrogallic red in the presence of cetyltrimethylammonium bromide are reported. Triple complex compounds formed by this reaction increase the sensitivity and selectivity of the spectrophotometric determination. (LK)

28354 STRIPPING-VOLTAMMETRIC DETERMINATION OF SELENIUM AND TELLURIUM IN HIGH-PURITY COPPER. Neiman, E. Ya.; Dolgopolova, G. M. (State Scientific-Research and Planning Inst. of Nonferrous-Metal Alloys and Processing, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 5, 651-653(May 1975).

Translated from Zavod. Lab.; 41: No. 5, 531-534(May 1975).

The conditions for a joint determination of selenium and tellurium by stripping voltammetry were studied, and a technique was developed for their determination in high-purity copper. Since the presence of iron(III) in the hydrochloric acid solutions does not interfere with the determination of Se and Te, coprecipitation with iron(III) hydroxide in ammoniacal medium was used to separate them from copper. (LK)

28355 USE OF CERTAIN NITROSO SUBSTITUTED PYRIDINEDIOLS AS ANALYTICAL REAGENTS FOR THE DETERMINATION OF SELECTED ELEMENTS. Reeves, R. R. Hattiesburg, MS; Univ. of Southern Mississippi (1975). 174p. University Microfilms Order No. 76-4459.

Thesis (Ph. D.).

A selected group of nitrosated pyridinediols was investigated for possible use as analytical reagents for the determination of Group VIII elements. Highly successful methods of analysis were developed for cobalt, osmium, and ruthenium. Complexes formed with iron and palladium showed some promise for analytical purposes. The newly developed methods were compared to those methods commonly available for similar analyses. Factors used for comparison included the molar absorptivities of the complexes, their formation constants, the range over which Beer's law was followed, the sensitivities of the methods, and the tolerance levels for seriously interfering ions. (LK)

28356 DETERMINATION OF DEUTERIUM IN WATER BY A THERMOMETRIC METHOD. Cabicar, J. (Faculty of Nuclear and Physical Engineering, Prague). Radiochem. Radioanal. Lett.; 24: No. 5-6, 341-345(4 Mar 1976).

A very simple and rapid method for the determination of deuterium in water has been developed. The method is based on the change of the thermal effect of the solubility of sodium sulfate in the presence of D_2O. The procedure is based on the measurement of the temperature of phase transition $Na_2SO_4 . 10H_2O \rightleftharpoons Na_2SO_4 + 10H_2O$. The sensitivity of the method proposed is comparable with mass spectrometry. (auth)

28357 COLORIMETRIC ESTIMATION OF Be(II), Sn(II), Hg(II), VO(II), Cr(III), AND Mo(VI) WITH POTASSIUM HEXACYANOCHROMATE(III). Malik, W. U.; Sharma, K. D. (Univ. of Roorkee, India). Indian J. Chem.; 13: No. 11, 1232-1233(Nov 1975).

Be(II), Sn(II), Hg(II), VO(II), Cr(III) and Mo(VI) can be estimated at the microgram level using potassium hexacyanochromate(III) as a colorimetric reagent. The development of color is achieved either by irradiating a mixture of metal salt solution and $K_3Cr(CN)_6$ with sunlight or UV light, or by using catalyzed aquation of the reagent by Cr(II). The anions like Cl^-, Br^-, I^-, NO_3^-, CH_3COO^- and CN^- do not interfere. The tolerance limits of interfering ions like Fe(II), Fe(III), Cu(II), Hg(I), Co(II), Ni(II), SO_4^{2-} and CO_3^{2-} have been determined. (auth)

28358 GAMMA-REZONANSNYE METODY I PRIBORY DLYA FAZOVOGO ANALIZA MINERAL'NOGO SYR'YA. (Gamma Resonance Methods and Equipment for Mineral Phase Analysis). Gol'danskii, V. I.; Dolenko, A. V.; Egiazarov, B. G.; Zaporozhets, V. M.; Ratnikov, V. M. Moscow; Atomizdat (1974). 144p.

Consideration is given to problems associated with the development and use of methods and equipment for mineral phase analysis, which are based on gamma resonance. The book contains the following, main sections: physical principles of gamma resonance; experimental technique of gamma resonance studies with an exposition of the theory of gamma resonance spectroscopy and a description of gamma-resonance spectrometers; gamma-resonance methods and equipment for analyzing cassiterite ores with results of their use under production conditions; gamma-resonance methods and equipment for phase analysis of iron-containing ores with a description of the results of experimental studies. (tr-auth)

28359 FLUORIMETRIC DETERMINATION OF BERYLLIUM WITH o-PYRIDINOPHENOL. Kabrt, L.; Holzbecher, Z. (Inst. of Chemical Tech., Prague). Collect. Czech. Chem. Commun.; 41: No. 2, 540-547(Feb 1976).

Fluorescence properties of o-pyridinophenol (2-(2-hydroxyphenyl)pyridine) and its complex with a beryllium salt were studied. A selective method was developed for fluorimetric determination of beryllium, with the limit of determination 1.6 ng Be/1 ml. (auth)

28360 4-CHLORO-2, 5-DIMETHOXYACETOACETANILIDE AS A GRAVIMETRIC REAGENT FOR BERYLLIUM(II) AND COPPER(II). Hundekar, A. M.; Umapathy, P.; Sen, D. N. (National Chemical Lab., Poona (India)). J. Indian Chem. Soc.; 52: No. 1, 71-74(Jan 1975).

4-chloro-2, 5-dimethoxyacetoacetanilide, has been found to precipitate Be(II) and Cu(II) ions from solutions, quantitatively in the pH range 5.8 to 6.5 and at slightly higher pHs. The precipitated complexes, having the compositions, $Be(C_{12}H_{13}O_4NCl)_2$, are stable and can be weighed directly after drying at 115° to 0°. A method for the estimation of these metal ions, using 4-chloro-2, 5-dimethoxyacetoacetanilide as a precipitant has been described. Beryllium (II) in presence of aluminium (III) and iron (III) and copper (II) in presence of aluminium (III), cadmium (II) and zinc (II) can be precipitated from solutions by masking the foreign ions with disodium salt of EDTA or ammonium fluoride. T. G. A. and D. T. A. data for the beryllium and copper complexes are also presented. (auth)

28361 EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF TRACE AMOUNTS OF MOLYBDENUM PRESENT IN ROCKS AND MINERALS. Pal, C. K.; Chakraburtty, A. K. (Jadavpur Univ., Calcutta (India). Dept. of Chemistry). J. Indian Chem. Soc.; 52: No. 2, 138-140(Feb 1975).

Molybdenum (VI) forms a yellow colored chelate with salicylhydroxamic acid at pH 2.5 to 3.0, which is extractable with isoamyl alcohol. The colored extract can be directly measured spectrophotometrically at 360 nm. The system follows Beer's law at these wavelengths over the concentration range 0.10 ppM to 10.0 ppM Mo. The colored species with a sensitivity, 0.010 μg Mo cm^{-2} (ϵ = 9020) at 345 nm and 0.014 μg Mo cm^{-2} (ϵ = 6730) at 360 nm, can be suitably used for determination of molybdenum present in geological specimens. (auth)

28362 CHEMILUMINESCENT REACTION LUMINOL OXIDATION BY OXYGEN AND HYDROGEN PEROXIDE IN AQUEOUS SOLUTIONS IN THE PRESENCE OF VANADIUM (4). Pilipenko, A. T.; Mitropolitska, E. V.; Lukovskaya, N. M. (Kievskij Gosudarstvennyj Univ. (Ukrainian SSR)). Ukr. Khim. Zh.; 41: No. 5, 525-529(May 1975). (In Russian)

For English translation see the journal Sov. Prog. Chem.

28363 KINETICS OF THERMOCHEMICAL REACTIONS OF URANIUM COMPOUNDS IN A GRAPHITE MATRIX IN THE DC ARC. Basic Considerations on the Role of Thermochemical Processes as Interference Effects in Spectrochemical Analysis. Rautschke, R. (Martin Luther Univ., Halle, Ger.); Amelung, G.; Nada, N.; Boumans, P. W. J. M.; Maessen, F. J. M. J. Spectrochim. Acta, Part B; 30: No. 10-11, 397-415(1975). (In German).

A theoretical discussion shows how thermochemical investigations in the dc arc must be incorporated in fundamental spectrochemical research in order to arrive at significant and useful conclusions about the part played by thermochemical reactions as sources of interelement interference. The theoretical discussion is linked with an experimental study of thermochemical processes occurring with uranium compounds in a graphite matrix. It was established that uranium compounds such as U_3O_8 and UO_2 are converted into carbides UC and UC_2 when arced in a dc graphite arc. The reactions were followed during the evaporation period. This was accomplished by quantitative x-ray diffraction analysis

of the reaction products present in the cavity after various arcing periods. In addition, the temporal change of the temperature in the electrode was measured by observing the fusing process with x-rays for a series of substances with known melting points. Comparison of the results of these investigations with those of spectroscopic observations revealed a close relationship between the thermochemical reactions and the evaporation behavior of uranium compounds. Measurements of the total intensity for when samples were burnt to completion showed unambiguously, however, that this total intensity is independent of the type of uranium compound (U_3O_8, UO_2, UC, UC_2) in the electrode cavity. These results indicate that thermochemical processes may exert a strong influence on the evaporation pattern, but do not affect the total number of free uranium atoms and ions that flow through the excitation zone during the evaporation period. The absence of "thermochemical interference effects" under the relevant experimental conditions was thus adequately proved. (auth)

28364 CONTRIBUTIONS TO THE ANALYSIS OF NUCLEAR RAW MATERIALS. X. Korkisch, J.; Huebner, H. (Univ., Vienna). Mikrochim. Acta; No. 1, 25-31(1976). (In German).

A method is described for separating manganese from large amounts of uranium prior to a determination by means of spectrophotometry. The separation of the manganese and of the uranium material is conducted by adsorption on a column of the strongly acidic cation exchanger Dowex 50, X8 from a mixture of 80 Vol % hexone, 10 vol % acetone and 10 vol % of 12 M nitric acid. Following elution of the adsorbed manganese by means of 2 M nitric acid the manganese is determined spectrophotometrically by employing the formaldoxime method. The method was used for the determination of manganese in standard specimens of U_3O_8 (0.9 to 8.1 ppM manganese) and a very good agreement of the results was achieved. (auth)

28365 FLUORIMETRIC TITRATION OF ZIRCONIUM IN THE PPM-RANGE. van der Linden, W. E.; den Boef, G.; Ozinga, W. (Univ. of Amsterdam). Mikrochim. Acta; No. 1, 83-88(1976).

A fluorimetric titration of zirconium(IV) with EDTA is proposed. The fluorescence intensity of the zirconium-morin complex is used to indicate the end-point. More than twenty other cations were investigated and it was found that they did not interfere, neither did common anions. Mercury(II) can only be tolerated in amount not exceeding that of zirconium. Bismuth(III) interferes and hafnium (IV) is titrated together with zirconium. The relative standard deviation of the titration of 10 ml of a solution containing 1 ppM of zirconium does not exceed 1.5%. (auth)

28366 STATUS AND DEVELOPMENT TRENDS IN THE AREA OF RADIOCHEMISTRY AND CHEMICAL NUCLEAR TECHNOLOGY. Chemistry of Radioactive Elements. Electrochemistry of Technetium. Jotschev, M.; Koch, H.; Kupsch, H. Isotopenpraxis; 11: No. 11, 369-378(1975).

A review is given recent research on the electrochemistry of Tc. The techniques used in the electrochemical analysis of Tc (polarography and coulometry) are discussed. Electrolytic and electrophoretic separation methods are described. (94 references) (JSR)

28367 DETERMINATION OF VANADIUM IN URINE. Pickova, J. (Karlova Universita, Prague (Czechoslovakia). Fakulta Vseobecneho Lekarstvi). Prac. Lek.; 26: No. 8, 302-304(Sep 1974). (In Czech).

Three methods are compared and evaluated of determining vanadium in the urine of man, namely the method based on the catalytic action of vanadium during the oxidation of organic amines and aminophenols by potassium chlorate, the method based on the formation of a color complex of vanadium(V) and 8-hydroxyquinoline, and the method based on the formation of a color complex of vanadium(IV) and pyrocatechin. For practical purposes the last named method was found most suitable thanks to its sensitivity and reproducibility, this despite its greater exactness for time. (INIS)

28368 SPECTROGRAPHIC DETERMINATION OF BERYLLIUM IN BERYLLIUM—COPPER ALLOYS WITH SOLUTION STANDARDS AND ROTATING GRAPHITE WHEEL ELECTRODE. Prakash, K.; Bagchi, S. N. (Central Scientific Instruments Organisation, Chandigarh (India)). CSIO Commun.; 1: No. 2, 31-33(Apr 1974).

A spectrographic method using synthetic solution standards, rotating graphite wheel electrode, and condensed spark for the determination of beryllium in beryllium–copper alloy has been described. The element can be determined to an accuracy of ±5% of the actual contents present. (auth)

28369 SPECTROCHEMICAL DETERMINATION OF SMALL AMOUNTS OF BORON IN MAGNESIA CLINKER. Temma, T.; Miwa, S. (Ministry of Finance, Chiba (Japan). Central Customs Lab.). Jpn. Anal.; 23: No. 8, 863-867(Aug 1974). (In Japanese)

Small amounts of boron in magnesia clinker from seawater and magnesite is determined by a spectrochemical technique using a graphite electrode. A magnesia clinker sample is pulverized to fine powder, and the powder (2g) is mixed homogeneously either with graphite powder (1.5g), barium fluoride (0.5g) as a carrier and potassium bichromate (0.2g) as an internal standard, or with graphite powder (2g), barium fluoride (2g) and zirconium oxide (3g). An aliquot of the powder thus obtained is subjected to the spectrochemical determination of small amounts of boron by dc arc discharge (20 amp, analytical gap 4 mm, pre-arc time 30 sec and exposure time 30 sec). The standard samples for making the working curve are prepared by the addition of a boric acid solution in pure magnesium oxide powder (no detectable boron). The working curve is an almost straight line in the boron range 10 ppM to 100 ppM, and the coefficients of variation for the determination are within 9%. The proposed method is very useful for the identification of the kind of magnesia clinker and for the control analysis of the products. (auth)

28370 THERMOGRAPHIC AND SPECTROGRAPHIC ANALYSIS OF RARE EARTHS DIIMINODIACETATE HYDRATES. Badalova, R. I.; Mitrofanova, N. D.; Martynenko, L. I. (Moskovskij Gosudarstvennyj Univ. (USSR). Kafedra Neorganicheskoj Khimii). Vestn. Mosk. Univ., Ser. II. Khim.; 15: No. 2, 181-184(Mar 1974). (In Russian)

For English translation see the journal Mosc. Univ. Chem. Bull.

28371 SYNERGISTIC EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF PLUTONIUM (VI). Shukla, J. P.; Manchanda, V. K.; Subramanian, M. S. (Bhabha Atomic Research Center, Trombay, India). J. Radioanal. Chem.; 29: No. 1, 61-68(1976).

A rapid method for the synergistic extraction and spectrophotometric determination of plutonium (VI) in milligram amounts using a mixture of thenoyltrifluoroacetone (TTA) and tributyl phosphate (TBP) in benzene has been developed. Quantitative extraction is obtained from aqueous solutions of pH = 2 affording separation from many commonly occurring impurities (viz., thorium, fission products and cladding materials). The precision and accuracy of the method has been found to be ~1%. The study of the solid product isolated from the extraction system indicates the stoichiometry of the extracted species as $PuO_2(TTA)_2TBP$. (auth)

28372 RATIONAL MULTIPLE USE OF A PALLADIUM FILTER IN THE SPECTRAL DETERMINATION OF HYDROGEN IN GASES WITH THE USE OF AN ISOTOPIC MARKER. Nemets, V. M.; Petrov, A. A.; Shabdukarimov, B. A. Zh. Prikl. Spektrosk.; 23: No. 4, 578-581(Oct 1975). (In Russian)

Ordinarily in analysis, a palladium filter is used only for the diffusion isolation of hydrogen from an analysis mixture. However, in the presence of oxygen, complete separation of hydrogen is not possible because of the formation of water vapor on the palladium surface. This behavior gives low analytical values for hydrogen. The introduction of an isotopic marker (deuterium) into the analysis mixture corrects this difficulty, but in this case also, analysis is not possible if the oxygen in the mixture significantly exceeds the hydrogen. In order to eliminate this flaw, a palladium filter is used to isolate hydrogen as water vapor and as a gas. With this variant of the method, the sensitivity is found to be at a level of $\sim 10^{-4}$ volume % hydrogen after applying suitable corrections for isotopic separation. The advantage of this procedure lies in the universality of its applicability over a wide variation in the composition of the analysis mixture. (SJR)

28373 SPECTROPHOTOMETRIC DETERMINATION OF RUTHENIUM (III) WITH THIORIDAZINE HYDROCHLORIDE. Gowda, H. S.; Ramappa, P. G. (Univ. of Mysore, India). Curr. Sci. (India); 45: No. 6, 218-219(20 Mar 1976).

Thioridazine hydrochloride was used for the spectrophotometric determination of ruthenium (III). The blue color developed to maximum intensity after 10 minutes at room temperature in 1.5 N H_2SO_4, is stable for 30 minutes, and has absorbance maximum at 640 nm. The Sandell sensitivity was found to be 0.022 μg Ru(III)cm^{-2}, and the molar absorptivity was 4.58×10^3 liter $mole^{-1}cm^{-1}$. The effects of the presence of other ions was discussed. (DDA)

28374 FLUORESCENT COMPLEXONES OF THE NAPHTHOL SERIES. Temkina, V. Ya.; Rusina, M. N.; Yaroshenko, G. F.; Branzaburg, M. Z.; Timakova, L. M.; Dyatlova, N. M. J. Gen. Chem. USSR (Engl. Transl.); 45: No. 7, 1530-1534(Jul 1975).

Translated from Zh. Obshch. Khim.; 45: No. 7, 1564-1570(Jul 1975).

New complexones of the naphthol series were synthesized and studied. The introduction of a carboxy group conjugated with the naphthalene ring into the ligand molecule leads to increase in the stability of the complexes, to selectivity toward a number of cations, and to the appearance of new fluorescence properties

that permit the application of these compounds as metal-fluorescence indicators for the complexometric determination of Lu^{3+} and Yb^{3+}. It was found that the iron complexonate derived from the doubled reagent has a uniquely high stability (log K 40). (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 29194, 29195, 29206, 29224, 29231, 29284, 29334, 29341, 29367, 29369–29371, 29399, 29413, 29417, 29502, 29747, 30140, and 32492.

28375 (NBL-277, pp 23-25) DETERMINATION OF URANIUM IN HARD-TO-DISSOLVE RESIDUES BY X-RAY FLUORESCENCE. Busch, A. J.; Yuster, H. G. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

A rapid x-ray fluorescence technique for the determination of uranium in calcined ash samples is discussed. (auth)

28376 (NBL-277, pp 46-58) EVALUATION OF THE LOS ALAMOS SCIENTIFIC LABORATORY BOMB SAMPLE DISSOLUTION TECHNIQUE AND AUTOMATED EXTRACTION SPECTROPHOTOMETER FOR URANIUM ASSAY. Hassell, C. Jr.; Paller, J. S.; Pietri, C. E. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

A system for the automated analysis of uranium samples, developed by the Los Alamos Scientific Laboratory (LASL), has been evaluated for ERDA and LASL at the New Brunswick Laboratory. The system consisted of a bomb dissolution technique employing a teflon-lined Parr bomb, filtration of sample solution, gamma counting of the residue to determine its uranium content, and assay of the filtrate for uranium by an automated extraction spectrophotometer. Tests and test results are described. (auth)

28377 (TRG-Report–2680(S), pp 16-18) SAM (SCANNING AUGER MICROSCOPY): THE DAWN OF A NEW TECHNIQUE. Ferguson, I. F. Sep 1975.

From 22nd UKAEA diffraction analysis conference; Dounreay, United Kingdom of Great Britain and Northern Ireland (UK) (15 Oct 1974).

In role of diffraction and electron analysis in the fast reactor programme. (UKAEA Reactor Group, Springfields).

Examples of scan Auger maps (images of spatial distribution of elements) are given using Type 316 stainless steel with a stress corrosion crack and a SiC-coated fuel particle. (DLC)

28378 (UCRL-Trans-11002) RADIOCHEMICAL MEASUREMENT OF THE SOLUBILITY OF SILVER HALIDES IN SILVER NITRATE SOLUTIONS AND THE COMPLEX FORMATION OF THE SILVER HALIDE WITH SILVER IONS. Lieser, K. H. Translated from Z. Anorg. Allg. Chem.; 304: No. 5/6, 296-306 (1960). 18p. Dep. NTIS $3.50.

The solubilities of the silver halides AgCl, AgBr, and AgI in solutions of silver nitrate (concentrations up to 2 moles per liter) were measured by radiochemical methods. The samples of the silver halides were labelled with ^{36}Cl, ^{82}Br, and ^{131}I, respectively. It follows from the calculated analysis of the solubility curves that the complexes $[Ag_2X]^+$ and $[Ag_3X]^{++}$ (X = Halogen) are formed in the solution. The dissociation constants of these complexes are calculated; the stabilities of complexes of the same kind increase from chloride to iodide. $[Ag_2X]^+$ complexes have lower stabilities than $[AgX_2]^-$-complexes; the complexes $[Ag_3X]^{++}$, however, possess stabilities being nearly as high as that of the complexes $[AgX_3]^{--}$. (auth)

28379 USE OF RADIOACTIVE SOURCES TO STUDY THE COMPOSITION OF THIN FILMS. Vander, I. Z.; Volkova, E. A.; Mikhailov, A. A.; Sinitsyna, G. S. Prikl. Yad. Spektrosk.; No. 5, 69-73(1975). (In Russian)

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

Thin films of SnO_2 and Al_2O_3, obtained by vapor phase pyrolytic hydrolysis of $SnCl_4$ and $AlCl_3$, were analyzed from the x-ray lines induced by the γ radiation of a ^{55}Fe source. The results showed the very high tendency of the SnO_2 to crystallization. The Cl content of the films were determined as a function of the deposition temperature and in both films the Cl content decreased as the deposition temperature was increased. The electroconductivity of the SnO_2 films increased with increase of deposition temperature, in contradiction with previously obtained data. The electrical conductivity of Al_2O_3 films did not increase as rapidly with increase of deposition temperature, since even at high deposition temperatures the concentration of amorphous oxide was still significant. (JSR)

28380 MEASUREMENT OF THE SPECIFIC ACTIVITY OF PLUTONIUM SOLUTIONS BY THE METHOD OF $4\pi\alpha-X_L$ COINCIDENCE. Antsiferov, V. T.; Geider'man, A. M.; Preobrazhenskaya, L. D.; Razumovskii, L. A.; Khol'nov, Yu. V. Prikl. Yad. Spektrosk.; No. 5, 198-202(1975). (In Russian)

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The reliability of the measurement of the specific activity of solutions by the $4\pi\alpha-X_L$ method was tested on Pu solutions of known activity. The techniques and principles of the method are described. The results show that this method can be used for precise determination of the activity of the isotopes of many transuranium elements in cases where there is an α decay at the low-lying excited level of the daughter nucleus whose γ transition is strongly converted to the ground state. (JSR)

28381 ASSAY OF ^{123}I. Hudson, F. R.; Glass, H. I.; Waters, S. L. (Hammersmith Hospital, London). J. Nucl. Med.; 17: No. 3, 220-222(Mar 1976).

Compounds labeled with ^{123}I are becoming more common in scintillation imaging due to the convenient combination of the 13.3-hr half-life and the 159-keV gamma radiation. Attention is drawn to the particularly large summing effects observed when ^{123}I is counted in a well counter. These could lead to errors in the assay of doses if the analyzer windows used are too narrow. (auth)

28382 DETERMINATION OF GADOLINIUM IN URANIUM BY X-RAY FLUORESCENCE ANALYSIS. Boniforti, R.; Riccardi, R. (CNEN, Casaccia, Italy). X-Ray Spectrom.; 4: No. 4, 159-160 (Oct 1975).

A method is presented for the determination of gadolinium in $Gd_2O_3 + UO_2$ pellets. The relative accuracy ranges between 1 and 2%. (auth)

28383 RADIOCHEMICAL DETERMINATION OF PHENYLMERCURY CHLORIDE IN THE ppB RANGE. Stary, J.; Prasilova, J. (Tech. Univ. of Prague). Radiochem. Radioanal. Lett.; 24: No. 2, 143-147(30 Jan 1976).

A very simple, rapid, and highly selective method for the determination of organomercuric compounds based on isotope exchange has been developed. The procedure consists in the addition of an excess of inorganic radiomercury to the sample under analysis and measuring the radioactivity of the separated organomercuric compound. The sensitivity of the determination of phenylmercury chloride (~1 ppB) can be further increased using radiomercury of higher specific activity. (auth)

28384 X-RAY FLUORESCENCE ANALYSIS OF THIN SLIME LAYERS. Betin, Yu. P.; Zhabin, E. G.; Krampit, I. A. Ind. Lab. (USSR) (Engl. Transl.); 41: No. 4, 522-523(Apr 1975).

Translated from Zavod. Lab.; 41: No. 4, 426-428(Apr 1975).

X-ray fluorescence samples were analyzed as thin layers of slime in an effort to eliminate the interferences that occur in the analysis of thick layers of powder. The slime, formed by finely divided powder in water, was pumped through an outlet to give a planar layer of known thickness. The jet of slime was exposed to gamma radiation from the strong radioisotope source, ^{241}Am (activity 0.54 Ci). Analysis of barium in silica was used to test the new technique. (DDA)

28385 ANALYSIS OF CHALCOPYRITE ORES BY RADIOISOTOPE X-RAY FLUORESCENCE. Kozlov, G. G.; Evseev, V. S.; Kormilitsin, G. A.; Przhiyalgovskii, S. M.; Etinger, V. R. (Central Combined Geological Group, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 4, 516-519(Apr 1975).

Translated from Zavod. Lab.; 41: No. 4, 420-423(Apr 1975).

Chalcopyrite ores from the Degtyar deposit were analyzed by x-ray fluorescence; and the principal elements were found to be 0.05–5% Cu, 0.1–7.0% Zn, 30–52% S, 25–50% Fe, and 0.5–10% Ba. Two types of x-ray spectrometers were used. The first type had primary radiation sources of ^{241}Am and used semiconductor detectors; and the second type used proportional counter detectors. Calibration curves constructed from artificial mixtures based on alumina in the absence of interfering elements were used to correct for interference in the first case; while differential filters were used to isolate element lines in the proportional counter method. A discussion of accuracy and reproducibility was included. (DDA)

28386 REDUCTION OF INTERFERENCES IN THE RADIOISOTOPIC X-RAY FLUORESCENCE ANALYSIS USING STANDARD-BACKGROUND METHOD. Bohenin, V. I. (Karaganda Polytechnic Inst., USSR). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 4, 534-535 (Apr 1975).

Translated from Zavod. Lab.; 41: No. 4, 435-436(Apr 1975).

In this standard background method, the powder samples are irradiated with photons from the source, Cd 109, and then with photons from the intermediate target made from the pure element being analyzed. When the current due to the scattered radiation

from the intermediate target is thus measured, a linear dependence on element concentration can be observed even at high concentrations. Samples of Zr concentrate and iron and copper ores were studied to test the method. (DDA)

28387 CHOICE OF RADIOCHROMATOGRAM SCAN CONDITIONS FOR THE USKh-1. Vinogradova, R. G.; Luzin, I. E.; Romanov, F. I.; Rys'ev, O. A. (Analytical Instrumentation Designs Office, Leningrad). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 5, 683-685(May 1975).

Translated from Zavod. Lab.; 41: No. 5, 556-560(May 1975).

Factors affecting optimal scanning conditions were studied. The speed cannot be high because of the restricted decay rate. The scan rate is governed in part by the width of the photocathode window, and the exact count rate is also dependent on the gap between the photomultiplier and the chromatogram, since this affects the light-collection factor when the chromatogram is saturated with scintillator. These factors also affect the resolution. Tritium-labelled guanosine was used in the study. (LK)

28388 A MICROMETHOD FOR QUANTITATIVE DETERMINATION OF LEUCINE FROM BIOLOGICAL EXPERIMENTAL MATERIAL USING THE DANSYLATION TECHNIQUE. Loessner, B.; Jork, R.; Matthies, H. (Medizinische Akademie, Magdeburg (German Democratic Republic). Inst. fuer Pharmakologie und Toxikologie). Acta Biol. Med. Ger.; 34: No. 1, 1-8(Jan 1975). (In German)

28389 ROENTGENORADIOMETRIC DETERMINATION OF SMALL CALCIUM CONCENTRATIONS IN SOLUTIONS. Mamikonyan, S. V.; Mel'ttser, L. V.; Filatov, V. I. pp No. 7 p.148-156 of Radiation Technology. Proceedings of VNIIRT. Moscow; Atomizdat (1972). (In Russian)

28390 SIMPLIFIED PROCEDURE IN RADIOISOTOPE DILUTION METHOD FOR THE MERCURY INVENTORY OF ELECTROLYTIC CHLORINE CELLS. Enomoto, S.; Kawakami, Y.; Senoo, M.; Imahashi, T.; Tachikawa, N.; Tominga, H. (Japan Atomic Energy Research Inst., Oarai, Ibaraki). Int. J. Appl. Radiat. Isot.; 26: No. 11, 671-675(Nov 1975).

A simple and safe procedure using the radioisotope dilution method for determining the mercury amount in electrolytic cells in the soda industry, has been investigated. The procedure developed is based on the correct supply by the Japan Atomic Energy Research Institute of the aliquots of radioactive mercury, i.e., ^{197}Hg, precisely weighed and the standard reference sample accurately diluted. A high accuracy was achieved with the standard deviation in the determination of less than 1%. (auth)

28391 APPLICATION OF A STABILIZED XRF SYSTEM IN MERCURY DETERMINATIONS OF MINERALS. Mancini, C. Isotopenpraxis; 11: No. 12, 417-418(1975).

A system of analysis for the rapid determination of mercury content in samples taken from Monte Amiata is described. The technique is based on the counting of Hg X_K-rays excited by a ^{57}Co source. Signal processing unit is characterized by an Automatic Gain Control Amplifier in order to correct pulse amplitude errors caused by detector or main amplifier gain shifts.

28392 CARBON 14 AND TRITIUM RADIOACTIVITY OF ALCOHOLS. Guerain, J.; Tourliere, S. (Union Nationale des Groupements de Distillateurs d'Alcool, 75-Paris (France)). Ind. Aliment. Agric. (Paris); 92: No. 7, 811-822(1975). (In French).

The method of measuring carbon 14 radioactivity of alcohols has been perfected in order to establish the correct determination of synthetic alcohol added to fermentation alcohol. The specific carbon and tritium activity of alcohol of different origins have been determined for 1973 and 1974. The Suess effect and nuclear fallout are observed. (FR)

28393 NEW METHOD FOR ANALYZING SURFACE AND SOLID COMPOSITION USING JETS. Marechal, M.; Devienne, M. F. (Societe Veeco, 75-Paris (France)). pp 248-255 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French).

From 4th international congress AVISEM 74. Application of Electronic and Ionic Processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces no. 171.

A new method of solid and solid surface analysis has been developed using molecular beams: M.B.S.A. (Molecular beam for surface and solid analysis). A rare gas molecular jet, 100-500 eV energy, is obtained by charge exchange with an ion beam of same gas. The jet hits the solid surface. The secondary ions emitted characterize the sample studied; they can be detected at the output of a mass spectrometer. The analysis method may be applied to any solid, either conducting or semiconducting or insulating. M.B.S.A. is also valid for the analysis of phenomena occurring at solid surfaces; the principle of the method is the same, but differences generally appear in applied technics. (FR)

28394 RADIOMETRIC DETERMINATION OF STRONTIUM WITH EDTA AND SOLVENT EXTRACTION. Kyrs, M.; Rais, J.; Selucky, P.; Kadlecova, L. (Inst. of Nuclear Research, Rez, Czech.). J. Radioanal. Chem.; 29: No. 1, 15-21(1976).

A radiometric determination of Sr was developed on the basis of the principle of concentration-dependent distribution using an insufficient amount of EDTA. The uncomplexed Sr is extracted into nitrobenzene in the presence of lithium dipicrylaminate. Amounts of ~1 μg Sr can be determined with an error of ~4%. The method can be also used for the determination of Ca. Formulas for the calculation of theoretical calibration curves have been derived and successfully verified. (auth)

Separation Procedures

Refer also to abstracts 28432, 28519, and 28579.

28395 (INIS-mf-1878) OBTAINMENT OF YTTRIUM CONCENTRATES, WITH SOLVENTS. Blatt, V. (Usina Santo Amaro, Sao Paulo (Brazil)). Jul 1974. 18p. (In Portuguese). INIS.

For obtaining Y concentrates solvent extraction was employed. The raw-material used was a solution of monazitic rare earth chlorides containing Y in the monazite's natural proportion: 1.5% Y_2O_3/RE_2O_3, and with a total rare earth oxide content of about 270 g RE_2O_3. The organic solvent employed was di-2-ethyl-hexyl phosphoric acid as to 20% in varsol. The organic and aqueous phases were submitted to multiple contact in a countercurrent system. Y, contaminated with some rare earths, passes to the organic phase in a proportion between 88% and 94%. Selective stripping of Y with a chloride solution in a double feeding system was used. The process control was accomplished through the analysis of the samples selected in each stage after reaching the equilibrium. A final aqueous solution (6-10g RE_2O_3/l) contains Y in the range of 75 to 85% Y_2O_3/RE_2O_3. An advantage of the stripping technique is that, through only a single extraction and stripping operation, it raises the content of Y from the range of 1.5% to 75 to 85%. A final solution containing this Yttrium needs only small readjustments for a following purification in columns with ion exchange resins. (INIS)

28396 (NBL-277, pp 7-11) EFFECT OF TECHNETIUM ON THE NBL METHOD OF DETERMINING URANIUM: A JOINT EFFORT WITH OAK RIDGE NATIONAL LABORATORY. Bodnar, L. Z. (New Brunswick Lab., NJ); Layton, F. L. Feb 1976.

In annual progress report, July 1974-June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

The assay of HTGR recycle fuel may involve the analysis of uranium which contains technetium-99. Methods of removing Tc from uranium samples are discussed. The best results were obtained by fuming the samples to complete dryness from a mixture of H_2SO_4 and $HClO_4$ in order to volatilize the Tc. (JSR)

28397 SEPARATION OF RADIONUCLIDES IN THE GAS PHASE. Baechmann, K. (Technische Univ. Darmstadt (F. R. Germany). Fachbereich Anorganische Chemie und Kernchemie). Z. Anal. Chem.; 276: No. 1, 1-9(Aug 1975). (In German).

12 figs.; 2 tabs.; 29 refs.

The separation of radionuclides in the gas phase is important for very different problems. In this study examples are given for the separation of very small quantities and the analytical sensitivity of on-line and off-line gas chromatography is compared. Examples are described for the separation by adsorption chromatography in a temperature gradient, for multidimensional gas chromatography using different reactive gases and for the separation by complex formation with the wall material. (DE)

28398 ELECTROOXIDATION OF MOLYBDENITE. Rozhdestvenskaya, Z. B.; Mazalov, I. F.; Zakharevskaya, G. N. (Kazakhskij Gosudarstvennyj Univ., Alma-Ata (USSR)). Izv. Vyssh. Uchebn. Zaved., Khim. Khim. Tekhnol.; 17: No. 8, 1197-1199 (1974). (In Russian)

In the electrooxidation of molybdenite in a chloride medium, the rate of the process depends essentially on the pH. A change in chloride ion concentration from 1 to 6 M does not affect the electrooxidation of the mineral. The effect of the chloride ion on the dissolution of molybdenite in electrolysis is related primarily to oxidation of sulfide by active forms of oxidant produced at the anode. (tr-auth)

28399 INFLUENCE OF PACKING ON THE EXTRACTION CHROMATOGRAPHIC BEHAVIOR OF THE RARE EARTHS IN THE SYSTEM DI-(2-ETHYLHEXYL) PHOSPHORIC ACID-CHROMOSORB-HYDROCHLORIC ACID. Vasilev, C.; Faitondjiev, L. (Chemische-Technologisches Institut, Sofia (Bulgarien). Abt. fuer

NE-Metallurgie); Havezov, I. (Bvlgarska Akademiya na Naukite, Sofia). Monatsh. Chem.; 105: No. 6, 1199-1205(Nov 1974). (In German)

The effect of saturation of the support with extractant on the height equivalent to a theoretical plate and capacity was studied from 0.25 to 1 g di(2-ethylhexyl)phosphoric acid per gram Chromosorb. The results were obtained in the case of high loading with rare earths in the column. (auth)

28400 BINDING CAPACITY OF ACID ALUMINA FOR MOLYBDENUM AND ITS POSSIBLE APPLICATION IN NUCLEAR MEDICINE. Colombetti, L. G. (Loyola Univ. Stritch School of Medicine, Chicago). Radiochem. Radioanal. Lett.; 24: No. 2, 81-89 (30 Jan 1976).

The binding capacity of acidic aluminum oxide for molybdenum ions was studied and it was found that columns containing 3.5 gm of Al_2O_3 can bind more than 21 mg of molybdenum, which is the equivalent to 2.1×10^4 Ci of ^{99}Mo. A generator of this size could not be made because of radiation damage to the column, but this data indicates the possibility of making columns of a size much larger than the ones actually in use. The possibility of reloading the column with ^{99}Mo time and again should be also considered. This study also shows that standard isotonic saline solution is safe to use. (auth)

28401 SEPARATION OF METAL IONS BY MEANS OF BASES. Komar, N. P. (Kharkov State Univ.). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 7, 981-987(Jul 1975).

Translated from Zavod. Lab.; 41: No. 7, 777-783(Jul 1975).

Theoretical calculations are presented which describe the separation of Fe^{3+} from Mg^{2+}, Ca^{2+}, Sr^{2+}, and Ba^{2+} in strong acid solutions by precipitation as $Fe(OH)_3$ with a weak base. Consideration of the ionic radii of the other ions in relation to Fe^{3+} indicate that probably only Mg^{2+}, if even that, would interfere with the precipitation; and even formation of a magnesioferrite of the spinel type with $HFeO_2$ seems very unlikely under the precipitation conditions described. Equilibria characterizing the interactions of H^+, Fe^{3+}, Mg^{2+}, and OH^- are examined in detail. From the equilibria, it is concluded that precipitation of Fe^{3+} is practically complete at $5 < pH < 6$, but only small quantities of $Mg(OH)_2$ start to precipitate at pH 9.42. The possibility of coprecipitation does exist, and this can be minimized by using a base such as pyridine since the pH at which $Mg(OH)_2$ begins to precipitate is unattainable with this base. (BLM)

28402 STUDIES ON ELECTRODEPOSITION OF ACTINIDE ELEMENTS FROM NON-AQUEOUS MEDIUM. Ramaniah, M. V.; Singh, R. J.; Awasthi, S. K.; Prakash, S. (Bhabha Atomic Research Centre, Bombay). Int. J. Appl. Radiat. Isot.; 26: No. 11, 648-650(Nov 1975).

Electrodeposition of uranium, neptunium and thorium from isopropyl alcohol media was studied in some detail with a view to understanding the mechanism of electrodeposition of actinides from organic media. The deposits obtained by the electrodeposition of uranium, thorium, and neptunium were examined by various techniques. The presence of a hydroxyl-rich layer at the cathode was detected using a phenolphthalein indicator. From the data gathered in this investigation it was concluded that these actinides are deposited as hydrolytic species from an organic medium as they are from an aqueous medium. (auth)

28403 INTERACTION OF SCANDIUM, YTTRIUM, AND LANTHANUM IONS WITH CATION-EXCHANGE RESINS. I. The Sorption of Scandium, Yttrium, and Lanthanum by KU-2 × 8 Cation-Exchange Resin. Kudryavskii, Yu. P.; Kazantsev, E. A.; Kazantsev, E. I.; Onosov, V. N. (Urals Polytechnic Inst., Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 6, 893-895(Jun 1975).

Translated from Zh. Fiz. Khim.; 49: No. 6, 1520-1524(Jun 1975).

The sorption of scandium, yttrium, and lanthanum from 0.1 N solutions in nitric acid has been studied in the pH range from 1.5 to the pH immediately preceding the precipitation of the hydroxides of the elements. The compositions of the hydroxocomplexes sorbed by the cation exchangers have been calculated and it has been established that the average hydroxyl number and the average specific charge of the scandium ions sorbed by the resin differ significantly from the corresponding values for the solution. In the course of the sorption process in the cation exchanger phase the composition of the ions becomes continually more complex—the hydroxyl number increases. (auth)

28404 SELECTIVITY OF THE ION-EXCHANGE SORPTION OF ALKALI METAL AND ALKALINE EARTH METAL CATIONS BY MONOCARBOXYCELLULOSE. Azhgirevich, L. P.; Kaputskii, F. N.; Kaputskii, V. E. (Belorussian State Univ., Minsk). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 6, 898-899(Jun 1975).

Translated from Zh. Fiz. Khim.; 49: No. 6, 1528-1529(Jun 1975).

The selectivity of the ion-exchange sorption of alkali metal and alkaline earth metal cations by monocarboxycellulose has been investigated over the entire range of saturations of the resin phase. An inversion in the sorption selectivity series of alkali metal cations has been observed. For initial low degrees of saturation of the monocarboxycellulose phase, the normal affinity series characteristic of sulphonic acid cation-exchange resins is observed: $Cs^+ > K^+ > Na^+ > Li^+$; with increase of the degree of saturation above $x_r = 0.4$, the selectivity series is completely inverted. The theory of local hydrolysis can account for this phenomenon. The normal acidity series has been observed for alkaline earth metal cations over the entire range of saturations. (auth)

28405 APPLICATION OF THE THEORY OF EQUILIBRIUM COMPLEXING CHROMATOGRAPHY TO THE DISPLACEMENT ELUTION OF RARE-EARTH METALS WITH A DIETHYLENETRIAMINEPENTA-ACETATE. III. Dependence of Phase Compositions in the Band of Rare-Earth Metals on the Concentration of the Displacing Ion. Sheptunov, V. N.; Maslova, G. B.; Nazarov, P. P.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 6, 931-932(Jun 1975).

Translated from Zh. Fiz. Khim.; 49: No. 6, 1573-1575(Jun 1975).

The dependence of the phase compositions in the band of rare-earth metals on the concentration of the displacing sodium ion in the eluant has been established, and the conditions for eluting these metals with a diethylenetriaminepenta-acetate solution have been determined in the presence of various concentrations of the displacing ion. (auth)

28406 RESERVE OSMOSIS OF BRINES WITH CELLULOSE ACETATE MEMBRANES. Pasternack, A. (Draegerwerk A. G., Luebeck (F. R. Germany). Abt. Grundlagenentwicklung Chemie). Meerestechnik; 6: No. 3, 83-89(Jun 1975). (In German).

Important advances in membrane research may be expected from the use of membrane techniques for the desalination of brackish and sea water. Starting from experimental work on the desalting of brines by use of celluloseacetate membranes, the author discusses the exchange of material in reverse osmosis. Various ways of describing the transition of material are outlined and evaluated. (DE)

28407 EXTRACTION OF MOLYBDENUM(VI) FROM HYDROCHLORIC ACID SOLUTIONS BY TRIISOOCYTLAMINE IN ORGANIC DILUENTS. Vieux, A. S.; Rutagengwa, N.; Noki, V. (Univ. Nationale du Zaire, Campus de Kinshasa). Inorg. Chem.; 15: No. 3, 722-725(Mar 1976).

The influence of the diluents, carbon tetrachloride, 1,2-dichlorobenzene, and 1,2-dichloroethane, on the extraction of Mo(VI) by triisooctylamine from HCl solutions of high acidity was investigated. The extraction was almost 100 percent complete from acidic solutions of low $[H^+]$ with a decrease in the extraction coefficient from 10^{-2} to 2M HCl implying successive protonation of anionic species to give $HMo_7O_{13}^-$ or a complex metal acid such as $H_2Mo_7O_{13}$, the formation of cationic species $HMo_2O_6^+$ which does not extract, and the cationic chloride complex MoO_2Cl^+. Extraction isotherms were determined for the various systems. In organic solutions saturated with Mo(VI), the ratio of the concentrations of R_3N, Mo(VI), and Cl remains virtually constant at 2 : 1 : 4 and was independent of the diluent, amine concentration, and the acidity. Studies were made to determine the composition of the Mo(VI) compound extracted by the amine chloride in which the organic phase was far from saturated with Mo(VI), and spectrophotometric data indicated that the formula $(R_3NH^+)_2MoO_2Cl_4^-$ best described the extracted complex. (BLM)

28408 PREPARATION AND CHARACTERIZATION OF ZIRCONIUM PHOSPHATE ION EXCHANGER SAMPLES WITH RESPECT TO THE SEPARATION OF HIGHLY ACTIVE ACTINOID ELEMENTS. Treplan, J. (1972). 109p. (In German). INIS. Thesis.

Inorganic ion exchangers are of growing interest in connection with separation processes of α-radiators of high specific activity, or with high gamma doses, because they have a considerably higher radiation resistance at their disposal compared to the commonly used organic ion exchangers. In opposition to their use, however, are the worse properties regarding capacity, chemical resistivity, exchange rate and reproducibility of the ion exchange bed. An attempt has been made to influence the properties of a typical representative of this group, zirconium phosphate (ZP), by systematic changing of the preparation parameters in such a manner that a sufficient capacity is obtained regarding tri-valent ions. In addition, information is to be gathered in order to clarify the connection between exchanger property and structure of the ZP. (DE)

28409 EXTRACTION OF NIOBIUM AND TANTALUM FLUORIDE AND CHLORIDE COMPLEXES WITH PYRAZOLONE DERIVATIVES. Akimov, V. K.; Murachasvili, U. A.; Busev, A. I.; Rudzit, G. P. (Scientific-Research Inst. for Organic Intermediates and Dyes, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 4, 473-474(Apr 1975).

Translated from Zavod. Lab.; 41: No. 4, 391-392(Apr 1975).

The solvent extraction of niobium and tantalum complexes of pyrazolone derivatives was studied for the purpose of determining conditions for separating niobium and tantalum from one another and from other elements. The comparison of solvents, pyrazolone derivatives, reagent concentrations, and acidity was presented graphically and in tabular form. Dichlorethane was found to be the preferred extraction solvent, diantipyrylmethylmethane and diantipyrylpropylmethane, the most effective pyrazolone derivatives for complexation. Extraction from HF solution was more effective than from HCl solution. (DDA)

28410 EXTRACTION OF TRIVALENT TRANSPLUTONIUM ELEMENTS FROM NITRIC ACID SOLUTIONS BY SOME ALKYLENE- AND VINYLENEDIPHOSPHINE OXIDES. Kabachnik, M. I.; Koiro, O. E.; Medved, T. Ya.; Myasoedov, B. F.; Nesterova, N. P.; Chmutova, M. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Dokl. Chem. (Engl. Transl.); 222: No. 4-6, 386-389 (Jun 1975).

Translated from Dokl. Akad. Nauk SSSR; 222: No. 6, 1346-1349 (Jun 1975).

Studies on the extraction of trivalent Am, Cm, Bk, Cf, and Eu by five different tetraarylalkylene (and vinylene) diphosphine dioxides from 0.5 to 15.7M solutions of HNO_3 indicated that the selectivity of the reagents and the order of extraction are determined chiefly by the structure of the bridge linking the P = 0 functional groups. Separation factors for all elements investigated were very low for extraction from 0.5 to 4M HNO_3; they reached a maximum at an HNO_3 concentration of 15.7M. (JGB)

28411 PLUTONIUM SEPARATION FROM TRANSPLUTONIUM AND RARE EARTH ELEMENTS BY GAS ADSORPTION CHROMATOGRAPHY OF CHLORIDES. Travnikov, S. S.; Davydov, A. V.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 24: No. 4, 281-289 (20 Feb 1976).

For the separation of plutonium and transplutonium, as well as rare earth fission fragment elements the method of gas adsorption chromatography of chlorides in the flow of the carrier-gas Ar + $SOCl_2$ in a quartz column in an isothermic range (500-550°C) has been used. The method allows to quantitatively isolate ^{239}Pu from samples containing milligram amounts of transplutonium and rare earth elements. The ^{239}Pu decontamination degree is 10^6. (auth)

28412 ANION EXCHANGE STUDIES OF THORIUM(IV) IN MALONATE SOLUTION SEPARATION FROM MIXTURES. Chakravorty, M.; Khopkar, S. M. (Indian Inst. of Tech., Bombay). Sep. Sci.; 10: No. 5, 623-631(1975).

The anion exchange behavior of a negatively charged complex of thorium is studied on Dowex-21 K. Various eluants were tried. Hydrochloric, sulfuric, and nitric acid, as well as chlorides, nitrates, and acetates of sodium and ammonium, were tested as eluants. The efficiency of various eluants was determined. Novel methods were developed for the separation of thorium from a large number of elements by the processes of selective sorption, selective elution, and gradient elution. The method was found to be applicable for the separation of thorium from fission product elements. (auth)

28413 ADSORPTION OF URANIUM FROM DILUTE AQUEOUS SOLUTION ON INORGANIC ADSORBENTS. Dai, M. H.; Wu, S. C. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Sep. Sci.; 10: No. 5, 633-638(1975).

The adsorption of uranium from a dilute aqueous solution by a large number of inorganic adsorbents has been investigated. A mixture of aluminum hydroxide, ferric hydroxide, and activated carbon in the weight ratio 1:3:4 has shown a high adsorbability for uranium. The separation of uranium from a dilute aqueous solution by this mixed adsorbent under various temperatures and pH values has been studied. The adsorbability was found to exhibit a maximum at pH 4.0 to 5.5 and to decrease with increasing temperature. A number of eluting solutions for the desorption of uranium from the mixed adsorbent were also tested; 1 N $(NH_4)_2CO_3$ was found to be the most suitable eluting solution (93 percent recovery of uranium). (auth)

28414 URANIUM RECOVERY FROM PHOSPHORIC ACID NEARS REALITY AS A COMMERCIAL URANIUM SOURCE. Ross, R. C. Eng. Min. J.; 176: No. 12, 80-85(Dec 1975).

From annual meeting of the American Nuclear Society; New Orleans, LA, USA (8 Jun 1975).

Estimates that 5.5-6 million lb U_3O_8 can be produced from the 30 percent acid stage in the wet process for the production of phosphoric acid has spurred producers of phosphoric acid to consider uranium recovery. Solvent extraction processes using capryl phosphoric acid (AEC extraction process, 1950's) or D_2T—a mixture of di(2-ethylhexyl)phosphoric acid and trioctylphosphine oxide (ORNL process, 1970) are described for uranium recovery from the 30 percent acid produced by digesting phosphate rock with sulfuric acid. Flowsheets are shown for the two processes. Some other recovery processes underway are mentioned. (BLM)

28415 INVESTIGATION OF THE ADSORPTION OF XENON ON NaX ZEOLITE WITHIN A BROAD RANGE OF PRESSURES AND TEMPERATURES. Fomkin, A. A.; Serpinskii, V. V.; Bering, B. P. (Inst. of Physical Chemistry, Moscow). Bull. Acad. Sci. USSR, Div. Chem. Sci.; 24: No. 6, 1147-1150(Jun 1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 24: No. 6, 1244-1248(Jun 1975).

The adsorption of Xenon on NaX Zeolite was measured in the pressure range from ~0.1 pascal to ~1.4×10^4 k pascals and from 150 to 370°K, i.e., from below melting point of xenon to above the critical point. The results were tabulated. In the initial portion of all the isotherms, a Henry region was detected, extending to the adsorption of ~0.15 m mole/g. The values of the Henry constants for all the temperatures were tabulated. The adsorption isotherms showed a linearity within the entire range of pressures and temperatures studied, and the linearity permitted the calculation of the adsorption equilibria at high pressures on the basis of the data characterizing the region of comparatively low pressures and temperatures. (auth)

28416 ANOMALOUS DEPENDENCE OF AMERICIUM(III) COMPLEXES AND COMPLEXES OF OTHER Me(III) WITH DIPHOSPHINE DIOXIDES ON THEIR STRUCTURE. Rozen, A. M.; Nikolotova, Z. I.; Kartasheva, N. A.; Yudina, K. S. Dokl. Phys. Chem. (Engl. Transl.); 222: No. 4-6, 604-607(Jun 1975).

Translated from Dokl. Akad. Nauk SSSR; 222: No. 5, 1151-1154(Jun 1975).

The strength of complexes decreases when the alkyl substituents of neutral organophosphorus compounds are replaced by the more electronegative phenyl groups. The opposite result was obtained during the extraction of Am(III) nitrate by diphosphine oxides. The anomalous dependence of the strength on the structure of alkylenediphosphines was also observed in the case of Cm, Pm, Pr, and Eu. (LK)

28417 EXTRACTION-SPECTROPHOTOMETRIC INVESTIGATION OF COMPLEXES FORMED FROM INTERACTION BETWEEN VANADIUM (2), 2,9-DIMETHYL-1,10-PHENANTHROLINE AND AMMONIUM RHODANIDE. Babenko, N. L.; Busev, A. I.; Blokh, M. Sh. (AN Kazakhskoj SSR, Alma-Ata. Inst. Metallurgii i Obogashcheniya). Zh. Neorg. Khim.; 20: No. 1, 203-205(Jan 1975). (In Russian)

For English translation see the journal Russ. J. Inorg. Chem.

28418 EFFECT OF NITRIC ACID AND URANIUM ON THE EXTRACTION OF HYDROFLUORIC ACID BY PRIMARY AMINES. Beranova, H.; Kuca, L. (Inst. of Nuclear Research, Prague). Collect. Czech. Chem. Commun.; 40: No. 12, 3608-3616(Dec 1975).

The extraction of hydrofluoric and nitric acids into Primene-JMT solutions in benzene was studied in dependence on the acid concentration in the aqueous phase. The effect of nitric acid and of uranium on the extraction of hydrofluoric acid was studied in $HF-HNO_3$ and $HF-UO_2F_2$ systems. The literature data on the extraction of hydrofluoric acid with tertiary amines were compared with the data obtained on the extraction of hydrofluoric acid with primary amines and those concerning the extraction of nitric acid with tertiary and primary amines were compared with the data obtained in the present paper. The distribution of uranyl fluoride was studied for varying concentrations of uranium in the aqueous and the amine in the organic phase. (auth)

28419 SORPTION OF METAL IONS ON A STRONG ACID CATION-EXCHANGER IN THE PRESENCE OF TRIETHYLENETETRAMINE-N, N, N', N'', N''', N'''-HEXAACETIC ACID. Yusaf, M.; Sixta, V.; Sulcek, Z. (Geological Survey, Prague) Collect. Czech. Chem. Commun.; 40: No. 12, 3645-3651(Dec 1975).

The effect of triethylenetetramine hexaacetic acid (TTHA) on the sorption of 20 metal ions on a strong acid cation-exchanger was studied. Distribution coefficients of Cu^{2+}, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Be^{2+}, Zn^{2+}, Cd^{2+}, Al^{3+}, In^{3+}, Tl^{+}, Th^{4+}, Pb^{2+}, Bi^{3+}, Cr^{3+}, UO_2^{2+}, Mn^{2+}, Fe^{3+}, Co^{2+} and Ni^{2+} were determined by the batch method in the system Dowex 50W X8 resin-buffered solution of the studied ion containing TTHA at varying concentration of hydro-

gen ions. The obtained dependences are presented in diagrams. (auth)

28420 SEPARATION OF METAL IONS BY ION-EXCHANGE CHROMATOGRAPHY FROM THE MEDIUM OF TRIETHYLENE-TETRAMINE-N, N, N′, N″, N‴, N⁗-HEXAACETIC ACID. Yusaf, M.; Sixta, V.; Sulcek, Z. (Geological Survey, Prague). Collect. Czech. Chem. Commun.; 40: No. 12, 3652-3658(Dec 1975).

Procedures for the separation of metal ions on the column of strong acid cation exchanger Dowex 50W X8 were worked out. They are based on the already determined distribution coefficients of 20 metal ions in the medium of triethylenetetramine-N, N, N′, N″, N‴, N⁗-hexaacetic acid. Some of the procedures were applied for the analyses of inorganic materials.

28421 EXTRACTION OF HYDROBROMIC ACID AND URANYL BROMIDE BY TRIOCTYLPHOSPHINE OXIDE IN CYCLOHEXANE AND CHLOROFORM. Mojski, M.; Poitrenaud, C. (Institut National des Sciences et Techniques Nucleaires, Gif-sur-Yvette, France). J. Radioanal. Chem.; 29: No. 1, 89-98(1976).

The extraction of HBr and UO_2Br_2 by solutions of trioctylphosphine oxide in cyclohexane and chloroform was examined. From distribution data it was concluded that bisolvates HBr · 2 TOPO and UO_2Br_2 · 2 TOPO were extracted, and the formation of $CHCl_3$ TOPO complex is indicated. The corresponding concentrations quotients were calculated. (auth)

28422 STUDIES ON THE EXTRACTION BEHAVIOR OF ZIRCONIUM FROM MIXED AQUEOUS MEDIA WITH TBP. Shabana, R.; Hafez, F. (Atomic Energy Establishment, Cairo). J. Radioanal. Chem.; 29: No. 1, 99-107(1976).

A systematic study is presented on the extraction of Zr(IV) by tri-n-butylphosphate from H_2SO_4, HNO_3, HCl and HBr solutions as well from binary mixtures of H_2SO_4 and halogen acids. It has been found that Zr(IV) extraction is appreciably increased by addition of halogen acid to sulfuric acid solutions. On the other hand, the presence of water-miscible alcohols and acetone was found to enhance Zr(IV) extraction from HCl and HNO_3 solutions. An investigation of extracted Zr complexes from pure acids and mixed aqueous media enabled an explanation of the observed enhancements. In the light of the obtained results, an extraction mechanism is suggested. (auth)

28423 SYNERGISTIC EXTRACTION STUDIES OF URANIUM (VI) AND PLUTONIUM (VI) WITH SOME β-DIKETONES AND HETEROCYCLIC N-OXIDES. Manchanda, V. K.; Shukla, J. P.; Subramanian, M. S. (Bhabha Atomic Research Center, Trombay, India). J. Radioanal. Chem.; 29: No. 1, 69-75(1976).

The equilibrium constants for coordination of methyl substituted pyridine N-oxides with plutonium (VI) thenoyl trifluoroacetonate in chloroform (K_s) follow an order similar to those of the analogous uranium (VI) complexes indicating steric hindrance to bonding in the case of ortho substituted pyridine N-oxides. The extraction constants (k) of Pu(VI) chelates with various β-diketones are found to be only marginally higher than the values for the corresponding uranium (VI) chelates which is in conformity with the close similarity of the ionic radii of PuO_2^{2+} and UO_2^{2+}. (auth)

28424 ION-EXCHANGE EXTRACTION OF CERTAIN RARE ELEMENTS FROM WASTES OF TITANIUM PRODUCTION. Kazantsev, E. A.; Kazantsev, E. I.; Bezvoritnii, V. A.; Kholmogorov, S. N.; Kudryavskii, Yu. P.; Onosov, V. N. (All-Union Scientific-Research and Design Inst. of the Aluminum, Magnesium, and Electrode Industries, Minsk). J. Appl. Chem. USSR (Engl. Transl.); 48: No. 8, 1740-1742(Aug 1975).

Translated from Zh. Prikl. Khim.; 48: No. 8, 1670-1673(Aug 1975).

Cation-exchangers containing phosphate and carboxyl functional groups can be used for extracting rare elements from the aqueous solutions obtained by leaching of spent melts from chlorination of titanium slags. Depending on the type of resin used and on the sorption and desorption conditions, the ion-exchange method can be used for extracting scandium, titanium, zirconium, and thorium from multicomponent solutions and subsequently obtaining either the combined product or concentrates of individual elements (scandium and thorium). (auth)

Inorganic, Organic, and Physical Chemistry

28425 (IME-TN-1/73) CALCULATION OF THE PARAMETERS OF THE FUOSS-ONSAGER EQUATION (F.O.). Comparison Between Published and Obtained Values, by Electronic Computation (IBM-1130). Fortes, R.; Lyra, J. L. C.; Pina, F. G. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). 1973. 8p. (In Portuguese). INIS.

One of the objectives of this work is to verify the agreement between the experimental and calculated conductimetric values by the equation of Fuoss-Onsager to A^+B^- electrolyte type in aqueous solution and liquid ammonia. To solve this problem, the necessary parameters are reported for the resolution program of Fuoss-Onsager equation, binding one confrontation among the results in the literature with the calculated results. The existence of small deviations from agreement with the published results by others, serves as a support for the resolution method adopted.

28426 (ORNL-5111, pp 26-29) CHEMISTRY IN SUPPORT OF FUSION REACTOR TECHNOLOGY. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Equilibria in hydrogen–isotope–controlled thermonuclear reactor (CTR)-blanket systems were studied. Data are tabulated on: equilibrium in liquid Li–hydrogen-isotope systems; calculated equilibrium constants for the $Li(g) + \frac{1}{2}H_2(g)$ equals LiH(g) equilibria; and calculated equilibrium concentrations for the vapor species Li, T_2, and LiT in a CTR. A mixed-isotope technique and the associated apparatus were developed for measuring the permeation of tritium through metals under simulated steam-generator conditions, and tested by measuring tritium permeation through clean nickel at 636 to 910°K. The effect of an oxide film on impeding the permeation of tritium through Incoloy 800 was also studied. Tests indicated that the Ce(III)/(IV) redox couple is not a suitable buffer for reducing TF to T_2 in a CTR blanket composed of Li_2BeF_4. (JGB)

28427 (ORNL-5111, pp 114-118) ELECTROCHEMISTRY. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Studies on the electrochemical behavior of coupled active–passive metal–electrolyte systems are reported. Titanium electrodes were used in an electrolyte of 1N H_2SO_4. Progress is reported in other studies including electroanalysis with the paced-bed silver electrode, electrochemical kinetics of sulfide reactions, part-per-billion electroanalysis with packed-bed electrodes, and electrochemical recovery of reducible inorganic pollutants from aqueous streams. (JGB)

Chemical and Physicochemical Properties

Refer also to abstracts 28362, 28370, 28616, 30299, 30301, 31007, 31060, 31104, and 31930.

28428 (COO-2807-1) EXPERIMENTAL INVESTIGATION OF THE CHEMISTRY OF EXCITED STATES OF RARE GASES. Quarterly Progress Report, October 15, 1975–January 15, 1976. Setser, D. W. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry). Jan 1976. Contract E(11-1)-2807. 73p. Dep. NTIS $5.00.

The product channels from interaction of metastable argon atoms ($^3P_{2,0}$) with a series of chlorine containing molecules (Cl_2, NOCl, ClO, HCl, CCl_4, PCl_3, $SnCl_4$) as well as some other molecules (Br_2, N_2O, NO_2, H_2S and COS) were investigated by emission spectroscopy. The rate constants for product channels were established by comparison of the emission intensities from the excited state products to the emission intensities from excited state Kr atoms, which have known rate constants for excitation by metastable argon atoms. Comparison of the individual product rate constants with previously determined total quenching rate constants of $Ar(^3P_{2,0})$ gave the branching ratios for emitting product channels. Although the measurements include the wavelength range from 120 to 800 nm, emphasis is placed upon the vacuum ultraviolet region and upon the ArCl*, ArBr* and ArO* product channels. The highest ArCl* yield, approximately 50 percent, was obtained for Cl_2 and ClO. Quenching mechanisms for the halogen containing reagents are discussed with an emphasis on analogy to reactions of alkali metal atoms with halogen containing molecules. The nature of the bound-free ArCl* emission also is discussed. Since the spectral response of the monochromator in the vacuum ultraviolet is of critical importance for assignment of rate constant values, the molecular branching ratio method employed for the calibration of the optical system is carefully described. (auth)

28429 (FRNC-TH-551) DETERMINATION OF LUMINESCENCE QUANTUM YIELDS AND STUDY OF THE ENERGY TRANSFER MECHANISMS BETWEEN THE Ce^{3+} AND Tb^{3+} IONS IN THE COMPOUNDS $La_{1-x-y}Ce_xTb_yPO_4$. Bourcet, J. C. (Lyon-1 Univ., 69 (France)). 1974. 287p. (In French). Dep. NTIS (US Sales Only) $9.25.

Thesis.

After a brief review of the preparation of the products studied, a description is given of the experimental method used for the

measurement of the luminescence quantum yields under excitation by uv wavelengths between 860 and 2900 Å. Experimental results are reported on the evolution with temperature and Ce and Tb concentration of the emission and excitation spectra. Variations of the luminescence decay constants are given for the principal radiation transitions observed for these ions. Theoretical studies made during the last few years on the energy transfer mechanisms are reviewed. The mechanisms proposed for the excitation energy transfer of a Ce^{3+} and a Tb^{3+} ion in these compounds are discussed and compared with other proposed mechanisms. (JSR)

28430 (INIS-mf-1895, pp 5-24) CHARGE-TRANSFER OF TETRAVALENT LANTHANIDE IONS IN OXIDES. Chapter 2. Hoefdraad, H. 12 Mar 1975.

This chapter has been submitted for publication in J. Inorg. Chem.; 20 refs., 2 tables, 4 figs.

In charge-transfer spectra of lanthanide ions in oxides. (Rijksuniversiteit Utrecht (Netherlands)).

The reflection spectra were studied of tetravalent Pr and Tb oxides in solid solution in Sr_2ZrO_4, Ba_2ZrO_4, $SrZrO_3$, $BaZrO_3$, $BaCeO_3$, $BaHfO_3$, and $BaThO_3$; and of CeO_2 in Sr_2ZrO_4, Ba_2ZrO_4, $BaZrO_3$, and $BaThO_3$ in concentrations up to 1 atomic percent, all diluted in MgO. All these compounds have the tetravalent metal ion surrounded by six O-atoms in octahedral coordination. With Pr and Tb, two absorption shoulders were found at 400 and 336 nm, which did not vary with temperature from 300 to 130°K. Tb in $BaZrO_3$ and in Ba_2ZrO_4 showed an additional shoulder at 455 nm with some temperature dependence. The Ce solid solutions showed only one absorption band at 312 nm. Next the tetravalent oxides were studied in solid solution in $ZrSiO_4$, $ZrGeO_4$, $ThGeO_4$, and ThO_2, in which they are surrounded by eight O-atoms in cubical coordination. With Ce again one band was found at about 320 nm and with Pr and Tb bands which varied somewhat with the host. It is argued that this variation is inherent in the cubical coordination itself. (INIS)

28431 (INIS-mf-1895, pp 39-45) GREEN EMITTING PRASEODYMIUM IN CALCIUM ZIRCONATE. Chapter 5. Hoefdraad, H.; Blasse, G. 12 Mar 1975.

This chapter has been submitted for publication to Phys. Status Solid B.

In charge-transfer spectra of lanthanide ions in oxides. (Rijksuniversiteit Utrecht (Netherlands)).

Pr_2O_3 in solid solution at a concentration of 1 at. % in $CaZrO_3$ with perovskite structure shows green luminescence only under ultraviolet light with the maximum of the excitation band at 245 nm. A detailed spectrum of the emission with a sharp maximum at 493.5 nm is given. The excitation can be ascribed to a $4f \rightarrow 5d$ transition. No $5d \rightarrow 4f$ luminescence could be detected, not even at 4 K. With Pr_2O_3 in calcium modified ZrO_2 ($0.15\ CaO \cdot 0.85\ ZrO_2$) having a fluorite structure, the 4f5d state is situated at much lower energies: 295 nm. Here the red emission is present with almost the same intensity as the green emission. (INIS)

28432 (ORNL-5111) CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING NOVEMBER 1, 1975. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 157p. Dep. NTIS $7.75.

Each of the thirteen sections on research progress has been abstracted and indexed separately for NSA/ERA/EDB. Sections listing publications, patents, lectures, and papers presented at meeting, supplementary activities, and an organization chart are also included. (JGB)

For abstracts of individual sections see: 28278, 28426, 28427, 28433–28438, 28587, 28596, and 29517.

28433 (ORNL-5111, pp 1-11) MOLTEN-SALT SYSTEMS. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Progress is reported on studies concerned with the molten-salt reactor program. Estimates of the deposition of Te on Hastelloy N surfaces in a molten salt breeder reactor (MSBR) were calculated. Experiments were conducted to evaluate the extent of Te-induced grain boundary cracking that occurs when Hastelloy N or its various modified alloys are exposed to Te vapor. Results of preliminary studies on hydrogen reduction equilibrium of UF_4 dissolved in molten fluoride mixtures and studies on the effects of oxygen on the equilibrium of UF_3–UF_4 molten fluoride solutions contained in graphite are reported. In studies on the chemistry of Na fluoroborate, the following compounds were prepared and characterized: H_3OBF_4, $BF_3 \cdot 2H_2O$, $HBF_2(OH)_2$, $NaBF_3OH$, $Na_2B_2F_6O$, and $Na_3B_3F_6O_3$. Progress in studies on the thermodynamics of corrosion product fluorides in molten-salt reactor coolants is given. In experiments on the chemistry of fluorination and fuel reconstitution, a detailed investigation of the reaction $UF_5(d) + \frac{1}{2}H_2(g)$ yields $UF_4(d) + HF(g)$ was carried out. A bench-scale test assembly incorporating a small packed-bed electrode of glassy carbon spheres was constructed and was tested on the LiCl–KCl eutectic system. (JGB)

28434 (ORNL-5111, pp 12-25) AQUEOUS SYSTEMS AND GEOTHERMAL ENERGY. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Studies on the hydrolysis of cations, including mononuclear and polynuclear hydrolysis species and their stability constants in aqueous solutions are reviewed. Data on the solubility of oxides and hydroxides are included. Results of chronopotentiometric measurements of the diffusivity of Cd^{2+} in hydrous melts of $Ca(NO_3)_2$ at various temperatures and concentrations of water are given. Exploratory studies on a 100-gpm titanium loop being remodeled for investigating the formation of silica precipitates and their properties as a function of brine composition, temperature, and flow conditions are reported. Data on the solubility of silica in water as a function of temperature agreed reasonably well with that in the literature. Initial results of studies on the ionization of water in NaCl solutions and the ionization and polymerization of silicic acid are reported. (JGB)

28435 (ORNL-5111, pp 45-47) ENVIRONMENTAL CHEMISTRY. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

As part of the investigation of transients in freon–oxygen–ozone systems, the reaction of $O(^1D)$ atoms with CF_2Cl_2 was studied by flash-photolyzing O_3 in the presence of O_2 and CF_2Cl_2. Studies have been initiated on formulating kinetic models for predicting the composition of chlorinated water discharged from power plant cooling systems and describing equilibrium and kinetic aspects of the chemistry of sulfur in the atmosphere. (JGB)

28436 (ORNL-5111, pp 96-113) CHEMICAL PHYSICS. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Progress is reported in the following structural chemistry studies: computer simulation of liquid Na and calculation of specific heat; properties of amorphous solid water; neutron diffraction studies of three hydrates of phosphotungstic acid; tertiary structural differences between microbial serine proteases and the pancreatic serine enzymes; an algebraic method for analyzing large rearrangement networks of isomeric molecules; the crystal and molecular structure of the complex of platinum diiodide with the dimer of dithioacetylacetone; a neutron diffraction study of the 1 : 1 molecular complex of 7,7,8,8-tetracyanoquinodimethane with p-terphenyl; the structure of saxitoxin; new organic conductors, the tetrathiofulvalene halogen complexes; and, neutron structural studies related to organic reactions. Progress is reported in the following studies on atomic and molecular collisions: crossed molecular beam studies of the reactions of UF_6 with alkali atoms; surface reactions and ionization of UF_6; hyper- and planar channeling of charge-state-selected 27.5 MeV oxygen ions in Ag; electron emission from fast oxygen and copper ions emerging from thin Au crystals in channeled and random directions; and, crossed molecular beam studies of excited atom reactions. Other studies include: ESR studies of aqueous solutions of peptides during photolysis; ESR studies of N-heterocyclic compounds in liquids during photolysis (2,6-pyridinedicarboxylic acid and pyridine carboxylate anions); transients in the H_2O–CO–CH_4–H_2; and bromine formation in the gamma radiolysis of aqueous bromide ion solutions. (JGB)

28437 (ORNL-5111, pp 85-92) ORGANIC CHEMISTRY, CATALYSIS, AND COAL RESEARCH. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

The structure of homoadamantane was investigated by NMR studies of the deuterium-labeled 4-homoadamantyl cation. In order to evaluate the ratio of endo, endo-6,2-hydride(6,2-H)-exo, exo-3,2-hydride(3,2-H) shifts in the 2-norbornyl cation, two related compounds were synthesized and solvolyzed. They are: 2-methyl-2-(DELTA^3-cyclopentenyl-1-d)-propyl nosylate and (+)-2-endo-camphenilyl-2-exo-d brosylate. A systematic study of charge-transfer complexes in an effort to synthesize organic conductors is reported. In studies on the catalytic hydrodesulfurization of coal, the role of low concentrations of H_2S in hydrogen on a commercial Co–Mo catalyst was investigated. Progress in research on the use of molten-salt catalysts in the hydrogasification of coal is reported. Results of experiments are reported in which thin films of carbon evaporated onto silica plates were partly overlaid with evaporated Ni in order to make microscopic observations of the catalysis of the reaction of carbon with hydrogen gas. Computer programs have been written for simulating a methanation reactor and a methane–steam reformer. (JGB)

28438 (ORNL-5111, pp 121-124) SURFACE CHEMISTRY. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Results of experiments on the adsorption of H_2O and nitrogen on annealed and irradiated lunar samples at various temperatures and pressures are reported. Progress is reported in studies on the surface properties of an Apollo 11 sample, the interaction of sorbed water with lunar fines, and the reaction of sorbed water with ground volcanic minerals. The heat of immersion of zirconium oxide was measured at a water temperature of 25 to 175°C. The sorption of vapors on samples of thorium and titanium oxides was studied as a function of temperature and pressure over the ir spectral region 2000 to 4000 cm^{-1}. (JGB)

28439 (RFP-Trans-177) DIRECT PROCESS FOR PRODUCING ANHYDROUS SODIUM CARBONATE BY CARBONATION OF CAUSTIC SODA. [nd]. Translation of French Patent 2,094,540. 2p. Dep. NTIS $3.50.

Anhydrous sodium carbonate is produced by carbonation of a caustic soda solution containing 48 to 50 percent NaOH. The solution is dispersed in an atomizer and smoke or combustion gases containing at least 10 to 12 percent CO_2 passed across this apparatus. The temperature of the reaction medium is maintained above 100°C by using sufficiently hot gas. The exothermic reaction of carbon dioxide with caustic soda permits direct production of anhydrous sodium carbonate and drying of the product obtained. The degree of atomization of the caustic soda solution can be modified in such a manner as to adjust the granulometry of the product obtained to a desired value. (JGB)

28440 (RFP-Trans-181) PHOSPHORUS COMPOUNDS AS COMPLEX LIGANDS. Saito, T. Translated from Kagaku Kogyo; 26: No. 2, 160-163(1975). 7p. Dep. NTIS $3.50.

Phosphines, phosphites, and phosphine oxides are discussed from the standpoint of preparation, properties, and their interactions with transition elements to form complexes. (JGB)

28441 ABSORPTION OF CIRCULARLY POLARIZED γ-RADIATION IN L- AND D-AMINO ACIDS. Keszthelyi, L. (Kozponti Fizikai Kutato Intezet, Szeged (Hungary); Magyar Tudomanyos Akademia Biologiai Kutato Kozpontja, Szeged. Biofizikai Intezet); Vincze, I. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Radiat. Environ. Biophys.; 12: No. 3, 181-185(1975). 1 fig.; 1 tab.; 8 refs.

No difference within the experimental error (~10^{-3}) was observed in the absorption of right- and left-circularly polarized γ-radiation in L- and D-tryptophan and tyrosine. For the measurements the 14.4 keV transition of ^{57}Fe was used and the analysis of the circularly polarized γ-radiation was performed by Moessbauer method. (DE)

28442 CHARGE DISTRIBUTION AND STRUCTURE OF COMPLEXES $Me^{I}GaCl_4$, $Me^{I}Ga_2Cl_7$, AND KAl_2Br_7 (Me^{I} = Na^+, K^+, Rb^+, Cs^+, Ga^+). An NQR Investigation (^{35}Cl, ^{69}Ga, ^{81}Br). Deeg, T.; Weiss, A. (Technische Univ. Darmstadt (F. R. Germany). Physikalische Chemie 3). Ber. Bunsenges. Phys. Chem.; 79: No. 6, 497-510(Jun 1975).

Frequencies for ^{35}Cl and $^{69}Ga^{III}$ NQR are reported for $MeGa^{III}Cl_7$ (Me = Na, K, Rb, Ga^{I}) together with the ^{35}Cl NQR frequencies for $MeGa^{III}Cl_4$ (Me = Na, K, Rb, Cs, Ga^{I}), and the ^{81}Br and ^{79}Br NQR frequencies for KAl_2Br_7. Most of the corresponding ^{37}Cl and $^{71}Ga^{III}$ resonances in $MeGa_2Cl_7$ are reported too. With the exception of $RbGaCl_4$ and $CsGaCl_4$ all NQR investigations were done as a function of the temperature. (DE)

28443 CHAIN INITIATION RATE IN THE REACTIONS OF HYDROGEN AND DEUTERIUM WITH OXYGEN. Azatyan, V. V.; Aleksandrov, E. N.; Troshin, A. F. (Inst. of Chemical Physics, Moscow). Kinet. Catal. (USSR) (Engl. Transl.); 16: No. 2, 261-265 (1975).

Translated from Kinet. Katel.; 16: No. 2, 306-311(1975).

Taking hydrogen combustion as a model chain-branched process, it is shown that the chain initiation kinetics can be studied by determining the rate of the overall process in the subcritical region. By this means the upper limits of the rate constants for the chain initiation reactions in the combustion of H_2 and D_2 were determined in the range 803-1250°K. (auth)

28444 ABSOLUTE DETERMINATION OF THE DEUTERIUM CONTENT OF HEAVY WATER, MEASUREMENT OF ABSOLUTE DENSITY. Calculation of the Absolute Density of Isotopically Pure $D_2{}^{16}O$ Under Experimental Conditions. Ceccaldi, M.; Riedinger, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91—Gif-sur-Yvette (France). Dept. de Recherche et Analyse); Girard, G. (Bureau International des Poids et Mesures, 92—Sevres (France)); Menache, M. (Institut Oceanographique, 75—Paris (France)). Metrologia; 11: No. 2, 53-65(Jun 1975). (In French).

The absolute density of two heavy water samples rich in deuterium (with a grade higher than 99.9%) was determined with the hydrostatic method. The exact isotopic composition of this water (hydrogen and oxygen isotopes) was very carefully studied. A theoretical estimate enabled the absolute density value of isotopically pure $D_2{}^{16}O$ to be obtained. This value was found to be 1104.750 $kg \cdot m^{-3}$ at t_{68} = 22.3°C and under the pressure of one atmosphere. (DE)

28445 MEASUREMENT OF THE CHAIN PROPAGATION AND TERMINATION RATE CONSTANTS FOR THE REACTION F_2 + $H_2(D_2)$ INHIBITED BY O_2. Vasil'ev, G. K.; Makarov, E. F.; Chernyshev, Yu. A. (Inst. of Chemical Physics, Moscow). Kinet. Catal. (USSR) (Engl. Transl.); 16: No. 2, 272-275(1975).

Translated from Kinet. Katel.; 16: No. 2, 320-324(1975).

Using the flash photolysis method under isothermal conditions at 300°K, determinations were made of the rate constant k_3 for the chain termination reaction $H(D) + O_2 + M \rightarrow HO_2(DO_2) + M$, and also of the ratios k_2/k_3, where k_2 is the rate constant for the chain propagation reaction $H(D) + F_2 \rightarrow HF(DF) + F$. (auth)

28446 SOLUBILITY OF XENON IN LIQUID SODIUM. Veleckis, E.; Cafasso, F. A.; Feder, H. M. (Argonne National Lab., IL). J. Chem. Eng. Data; 21: No. 1, 75-76(Jan 1976).

The solubility of xenon in liquid sodium was measured as a function of pressure (2-8 atm) and temperature (350-600°C). Henry's law was obeyed with the value of the Henry's law constant, K/sub H/ equals N/sub Xe//P, ranging from 1.38 x 10^{-10} atm^{-1} at 350°C to 1.59 x 10^{-8} atm^{-1} at 600°C, where N/sub Xe/ and P are the atom fraction and the partial pressure of xenon, respectively. The temperature dependence of solubility may be represented by $\log_{10}$ lambda equals (0.663 +- 0.01)-(4500 +- 73) T^{-1}, where lambda is the Ostwald coefficient (the volume of xenon dissolved per unit volume of sodium at the temperature of the experiment). The heat of solution of xenon in sodium was 20.6 +- 0.7 kcal/mole, where the standard state of xenon is defined as that of 1 mol of an ideal gas, confined to a volume equal to the molar volume of sodium.

28447 THERMODYNAMIC PROPERTIES OF HEAVY WATER AT THE LINE OF SATURATION. Lagutkin, O. D.; Kuropatkin, E. I. (Odessa Technological Inst. of the Food Industry). Izv. Vyssh. Uchebn. Zaved., Energ.; No. 10, 65-68(1974). (In Russian).

The values of the specific volume of saturated vapor of heavy water along the saturation line were determined by thermodynamic similarity method taking into consideration the interrelation of the residual thermodynamic parameters in the saturation state. The values obtained were tabulated for temperatures from 10 to 370°C. An equation derived can be used to calculate the specific volume for D_2O vapor at any temperature. (JSR)

28448 PROTON MAGNETIC RESONANCE IN COBALT AND NICKEL ACETATE TETRAHYDRATES. Padmanabhan, A. C.; Rangarajan, G.; Srinivasan, R. (Indian Inst. of Science, Bangalore. Dept. of Physics). Proc. Indian Natl. Sci. Acad., Part A; 40: No. 3, 247-267(May 1974).

Proton magnetic resonance studies of several paramagnetic hydrates by the Pake method have been published, in the literature, but these had all been cases where a pronounced paramagnetic shift was not observed at room temperature. But in cobalt and nickel acetate tetrahydrates, even at room temperature, the hyperfine interaction is revealed by an asymmetry in the signals. Experiments were conducted at room and liquid nitrogen temperatures and at different magnetic fields to confirm that the asymmetry is caused by the paramagnetic shift. A procedure for analyzing the complex asymmetric signals which are obtained at room temperature is explained. The analysis indicates that the hydrogen bonding schemes are similar to that in magnesium acetate. The insufficient ESR data available, and the low symmetry of the crystal precluded a complete quantitative evaluation of the hyperfine interaction, from the observed shift data. Nickel acetate tetrahydrate seems to show a dipolar type of hyperfine interaction which is less modified by the magnetic anisotropies, than cobalt acetate tetrahydrate. (auth)

28449 REACTIONS OF ORGANOMERCURY CHLORIDES WITH LITHIUM DEUTERIDE. Zhil'tsov, S. F.; Kachaeva, L. I.; Druzhkov, O. N. (Gor'kii Pediagorgic Inst., Moscow). J. Gen. Chem. USSR (Engl. Transl.); 45: No. 8, 1959-1961(Aug 1975).

Translated from Zh. Obshch. Khim.; 45: No. 8, 1793-1795(Aug 1975).

The reactions of chloroisopropylmercury, benzylchloromercury, and chlorophenylmercury with lithium deuteride were studied. Their mechanism is discussed from the point of view of processes of one-electron transfer. (auth)

28450 RAMAN SPECTRA OF CRYSTALLINE $KBr^{18}O_3$. Holtzscheiter, E. W.; Johnson, E. R. (Univ. of Maryland, College Park). Int. J. Appl. Radiat. Isot.; 26: No. 12, 780-781(1975).

Raman spectra of normal crystalline $KBrO_3$, of crystalline $KBr^{18}O_3$ containing approximately 70% ^{18}O and of isotopically enriched $KBr^{18}O_3$ after irradiation in air showing relative changes in peak heights are shown. These spectra were taken at liquid nitrogen temperatures using the 4880 Å line of an Ar^{2+} ion laser and a Spex Model 1400 monochromator with about 1 cm^{-1} resolution, using the pressed pellet technique. (UK)

28451 INVESTIGATION OF ZIRCONIUM(4) AND HAFNIUM(4) STATES IN PERCHLORATE SOLUTIONS. Alekseeva, I. I.; Nemzer, I. I.; Yuranova, L. I. (Moskovskij Inst. Tonkoj Khimicheskoj Tekhnologii (USSR)). Zh. Neorg. Khim.; 20: No. 1, 92-96(Jan 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28452 PROPERTIES OF SOLUTIONS OF THE $CsNO_3$-$Ni(NO_3)_2$-H_2O SYSTEM AT 25°C. Andreeva, T. A.; Pozharskaya, S. S. Zh. Neorg. Khim.; 20: No. 3, 769-773(Mar 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28453 DOUBLE ALUMINIUM LITHIUM HYDROXOBORATES. Ashchyan, T. O.; Danilov, V. P.; Lepeshkov, I. N.; Kostyleva, O. F. (AN SSSR, Moscow. Inst. Obshchej i Neorganicheskoj Khimii). Zh. Neorg. Khim.; 20: No. 1, 44-47(Jan 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28454 SYNTHESIS AND INVESTIGATION OF POLYZIRCONO-ORGANOSILOXANES. Avilova, T. P.; Bykov, V. T.; Uglenko, A. V.; Shabalina, E. I. (Dal'nevostochnyj Gosudarstvennyj Univ., Vladivostok (USSR)). Vysokomol. Soedin.; 17: No. 2, 143-145 (Feb 1975). (In Russian)

28455 POTENTIOMETRIC INVESTIGATION OF Co(2)-, Ni(2)-, Cu(2)-, Zn(2)- AND Cd(2) CHLORIDE COMPLEXES IN CALCIUM CHLORIDE SOLUTIONS IN TRIBUTYL PHOSPHATE. Belousov, E. A.; Mironov, V. E.; Konstantinova, K. K.; Alovyajnikov, A. A. Zh. Neorg. Khim.; 20: No. 1, 247-249(Jan 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28456 ON PROPERTIES OF SULFATE COMPLEXES OF MONOVALENT METALS. Bukhalova, G. A.; Kozachenko, E. L.; Sementsova, D. V.; Keropyan, V. V. (Rostovskij-na-Donu Inzhenerno-Stroitel'nyj Inst. (USSR)). Zh. Neorg. Khim.; 20: No. 3, 615-618(Mar 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28457 INVESTIGATION INTO KINETICS OF COMPLEXING OF ZIRCONIUM(4) WITH XYLENOL ORANGE AND OF ITS POLYMERIZATION IN HYDROCHLORIC-ACID SOLUTIONS. Denisova, T. I.; Sheka, I. A. (AN SSSR, Moscow. Inst. Obshchej i Neorganicheskoj Khimii). Zh. Neorg. Khim.; 20: No. 3, 660-663(Mar 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28458 HOLMIUM BISDIPIVALOYLMETHANATE. Dzyubenko, N. G.; Martynenko, L. I.; Spitsyn, V. I. (Moskovskij Gosudarstvennyj Univ. (USSR). Kafedra Neorganicheskoj Khimii). Zh. Neorg. Khim.; 20: No. 1, 63-65(Jan 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28459 ON THE INTERACTION OF VANADIUM(2) WITH O-PHENANTHROLINE. Grigor'eva, M. F.; Pankrat'eva, V. I.; Tserkovnitskaya, I. A. (Leningradskij Gosudarstvennyj Univ. (USSR)). Zh. Neorg. Khim.; 20: No. 3, 667-672(Mar 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28460 $Cd(ClO_4)_2$-$CO(NH_2)_2$-H_2O SYSTEM AT 25°C. Karnaukhov, A. S.; Ashikhmina, T. Ya.; Runov, N. N. (Yaroslavskij Gosudarstvennyj Pedagogicheskij Inst. (USSR)). Zh. Neorg. Khim.; 20: No. 3, 795-799(Mar 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28461 INFRARED SPECTRA AND COVALENCY OF RARE EARTH FORMATES 210. CHEMISTRY SYMPOSIUM. Kartha, V. B.; Thakur, N. V. (Bhabha Atomic Research Centre, Bombay (India)). pp 165-168 of Proceedings of the Chemistry Symposium [Held at] Aligarh, December 21-23, 1972. Vol. II. Physical Methods in Structural Inorganic Chemistry, Actinide Chemistry and Solid State Studies. Bombay; Department of Atomic Energy (1973).
From chemistry symposium; Aligarh, India (21 Dec 1972). 2 tables.
The infrared spectra of rare earth formates in the 4000-650 cm^{-1} region is presented. It is shown that the C-H stretching frequency is a sensitive measure of the extent of coordination to the metal. It provides a better measure of the covalency of ligand-metal bond, compared to C00 frequencies which are mixed with other modes and consequently broadened or split. It is also shown that the strength of the bonding increases from La to Gd. (auth)

28462 STRUCTURAL PRINCIPLES IN HETEROPOLYCOMPOUNDS CHEMISTRY. Kazanskij, L. P.; Torchenkova, E. A.; Spitsyn, V. I. (Moskovskij Gosudarstvennyj Univ. (USSR). Kafedra Neorganicheskoj Khimii). Usp. Khim.; 43: No. 7, 1137-1159 (Jul 1974). (In Russian)
191 refs; for English translation see the journal Russ. Chem. Rev.

28463 INVESTIGATION INTO THIOCYANATE COMPLEXES OF METALS WITH o-, m-, p-METHOXYBENZOYLHYDRAZINES. Kharitonov, Yu. Ya.; Machkhoshvili, R. I.; Generalova, N. B.; Shchelokov, R. N. (AN SSSR, Moscow. Inst. Obshchej i Neorganicheskoj Khimii). Zh. Neorg. Khim.; 20: No. 3, 693-700 (Mar 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28464 SYNTHESIS AND STRUCTURE OF $ReCl_4NOCH_3CN$ COMPLEX. Khodashova, T. S.; Sergienko, V. S.; Ovchinnikova, N. A.; Glushkova, M. A.; Poraj-Koshits, M. A. (AN SSSR, Moscow. Inst. Obshchej i Neorganicheskoj Khimii). Zh. Neorg. Khim.; 20: No. 3, 731-734(Mar 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28465 STUDY INTO COMPOSITION AND THERMAL DECOMPOSITION PROCESSES OF HYDRATED SAMPLES OF CERIUM TETRAFLUORIDE. Kiselev, Yu. M.; Martynenko, L. I.; Spitsyn, V. I. (Moskovskij Gosudarstvennyj Univ. (USSR)). Zh. Neorg. Khim.; 20: No. 3, 576-581(Mar 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28466 ON INTERACTION OF ZIRCONIUM, TITANIUM(4), ALUMINIUM AND CHROMIUM(3) IN SULFATE SOLUTIONS. Kolpachkova, N. M.; Majskaya, T. Z.; Nekhamkin, L. G.; Zajtsev, L. M. (Gosudarstvennyj Nauchno-Issledovatel'skij i Proektnyj Inst. Redkometallicheskoj Promyshlennosti, Moscow (USSR)). Zh. Neorg. Khim.; 20: No. 1, 97-100(Jan 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28467 SYNTHESIS, PROPERTIES AND FORMATION CONDITIONS OF SCANDIUM ARSENITES. Komissarova, L. N.; Khrameeva, N. P.; Pushkina, G. Ya.; Chernova, N. A. (Moskovskij Gosudarstvennyj Univ. (USSR). Kafedra Neorganicheskoj Khimii). Zh. Neorg. Khim.; 20: No. 3, 624-630(Mar 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28468 POTENTIOMETRIC INVESTIGATION INTO COMPLEXING OF RHENIUM(5) WITH 1-METHYL-2-MERCAPTOIMIDAZOLE. Kotegov, K. V.; Zegzhda, G. D.; Amindzhanov, A. A.; Kukushkin, Yu. N. (Ural'skij Politekhnicheskij Inst., Sverdlovsk (USSR)). Zh. Neorg. Khim.; 20: No. 1, 115-117(Jan 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28469 RAMAN SPECTRA OF MoO_2Cl_2 AND MoO_2Br_2 VAPORS. Kovba, V. M.; Mal'tsev, A. A. Zh. Neorg. Khim.; 20: No. 1, 22-24(Jan 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28470 ESR INVESTIGATION INTO REACTION OF VANADATE REDUCTION BY ASCORBIC ACID. Kriss, E. E.; Yatsimirskij, K. B.; Kurbatova, G. T.; Grigor'eva, A. S. (AN Ukrainskoj SSR, Kiev. Inst. Fizicheskoj Khimii). Zh. Neorg. Khim.; 20: No. 1, 101-107(Jan 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Khim.

28471 ESR INVESTIGATION INTO KINETICS OF POLYVANADATE REDUCTION BY ASCORBIC ACID. Kriss, E. E.; Kurbatova, G. T.; Yatsimirskij, K. B. Zh. Neorg. Khim.; 20: No. 1, 108-111(Jan 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28472 INVESTIGATION OF CHLORIDE-IODIDE COMPLEXES OF CADMIUM. Kutuzova, M. Ya.; Leshchishina, L. E.; Fedorov, V. A. (Sibirskij Tekhnologicheskij Inst., Krasnoyarsk (USSR). Kafedra Neorganicheskoj Khimii). Zh. Neorg. Khim.; 20: No. 3, 817-820(Mar 1975). (In Russian)
For English translation see the journal Russ. J. Inorg. Chem.

28473 THERMAL INVESTIGATION OF ETHYLXANTHATE, DIETHYLDITHIOPHOSPHATE AND DIETHYLDITHIOCARBAMATE CHELATES OF SOME METALS. Larionov, S. V.; Kosareva, L. A.; Malikova, A. F. (AN SSSR, Novosibirsk. Inst. Neorganicheskoj Khimii). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 9, 120-126(Jul 1974). (In Russian)

From 5th all-union conference for thermal analysis; Novosibirsk (3 Jul 1973). For English translation see the journal Sib. Chem. J.

28474 SOME DIOXOMOLYBDENUM (IV) COMPLEXES WITH MONOLIGANDS–THEIR STRUCTURAL AND BONDING ASPECTS. Majumdar, A. K.; Bhattacharyya, R. G.; Bera, D. C. (Jadavpur Univ., Calcutta (India)). pp 121-125 of Proceedings of the Chemistry Symposium [Held at] Aligarh, December 21-23, 1972. Vol. II. Physical Methods in Structural Inorganic Chemistry, Actinide Chemistry and Solid State Studies. Bombay; Department of Atomic Energy (1973).

From chemistry symposium; Aligarh, India (21 Dec 1972). 16 refs.

A number of dioxomolybdenum (VI) complexes of the type $MoO_2X_2L_2$ where X = Cl and NO_3 and L = triphenyl phosphine oxide, quinoline N-oxide, dimethyl sulfoxide, hexamethyl phosphoramide and benzylamine (L_2) were isolated and characterized by different physicochemical methods. In all these compounds, the MoO_2 group is presumed to be in cis-configuration (C_{2v}), since their ir spectra indicate that both ν_1 and ν_3 of the said group are infrared active. Infrared spectra also bear the evidence of the existence of chelated (C_{2v}; ν_1 and ν_4 separation quite appreciable) as also ionic nitrate groups in the nitrate complexes. The magnetic character of MoO_2^{2+} ion is unpredictable. In some complexes, the ion is paramagnetic and in others it exhibits diamagnetism. A peroxo-complex, $MoO_2O_2{}^2C_6H_5CH_2NH_2$, with co-ordinated peroxo group, was also prepared and characterized. (auth)

28475 MIXED THALLIUM FLUORIDOHALOGENIDES. Batsanov, S. S.; Stas, M. N. Zh. Neorg. Khim.; 20: No. 3, 826-828 (Mar 1975). (In Russian)

For English translation see the journal Russ. J. Inorg. Chem.

28476 QUANTITATIVE STUDY OF THE ELEMENTARY GAS PHASE REACTION OF ATOMIC OXYGEN (^3P) WITH DEUTERIUM BROMIDE. Balakhnin, V. P.; Dement'ev, A. P.; Egorov, V. I. (Inst. of Chemical Physics, Moscow). Dokl. Phys. Chem. (Engl. Transl.); 223: No. 1-3, 661-664(Jul 1975).

Translated from Dokl. Akad. Nauk SSR; 223: No. 1, 108-111 (Jul 1975).

ESR was used to study the reactions of atomic oxygen with HBr and DBr, with the purpose of determining the contribution tunneling might make to these reactions. The absolute rate constants and preexponential factors were found to differ by a factor of three, and the true activation energy and the measured activation energy were found to be identical; however, the precise role of tunneling was not elucidated. (DDA)

Isotope Effects

Refer also to abstracts 28553, 28581, 31057–31059, 31061, 31132, 31169, and 32036.

28477 (COO-3127-12) THEORY OF INVERSE ISOTOPE EFFECTS. Ishida, T.; Kornblum, Z. C.; Pollin, J. S. (Brooklyn Coll., N. Y. (USA). Dept. of Chemistry). 1975. 80p. (CONF-7509119–1). Dep. NTIS $5.00.

From international conference on isotope in der natur; Gera, German Democratic Republic (22 Sep 1975).

The inverse isotope effect in isotope exchange equilibria is attributable to the temperature-dependent contributions from various vibrationally excited states. The inverse effects are predictable from the single-term G(u)-approximation. Crossover and other anomalies of the temperature-dependence of isotope-exchange equilibria are discussed in terms of the finite orthogonal expansion of the reduced partition function ratio. The inverse vapor pressure isotope effect in polyatomic molecules is discussed within the framework of the simple cell model. The inverse effect is due to the isotopic difference in the shifts of zero-point energy of internal vibrations upon condensation. The zero-point shift on condensation of nonpolar molecule is related to the cartesian dipole moment derivatives. The latter are calculated by means of a self-consistent field molecular orbital theory. A Medium Cluster Model is proposed as an extension of the cell model of liquid as a basis of the vapor pressure isotope effect. The liquid phase is represented by a cluster consisting of a central molecule and several shell molecules. (auth)

28478 DOMAIN STRUCTURE OF MONOCRYSTALS OF ORDINARY AND DEUTERATED TRIGLYCINSELENATE AS A FUNCTION OF THE GROWTH CONDITIONS. Tsedrik, M. S.; Saborovskii, G. A.; Demidovich, N. P. (Minsk State Univ.). Dokl. Akad. Nauk BSSR; 19: No. 10, 887-890(Oct 1975). (In Russian)

The change in the domain structure of ordinary and deuterated triglycinselenate was studied as a function of the growth conditions. Qualitative and quantitative analyses were made for the growth pyramid (110) and (001). For crystals grown in Seignette phase, the number of domains in 1 mm length decreases with increase of the temperature of growth, during which $n_{110} > n_{001}$. Close to the phase transition temperature n has a maximum, then decreases some and $n_{110} < n_{001}$. A possible explanation is given for the behavior of the domain structure. (tr-auth)

28479 ^{53}Cr FOURIER TRANSFORM NUCLEAR MAGNETIC RESONANCE STUDIES. Epperlein, B. W.; Krueger, H.; Lutz, O.; Nolle, A. (Tuebingen Univ. (F. R. Germany). Pharmakologisches Inst.); Mayr, W. (Tuebingen Univ. (F. R. Germany). Inst. fuer Chemie). Z. Naturforsch., A; 30: No. 10, 1237-1240 (Oct 1975).

In various alkali chromate solutions in H_2O and D_2O the dependence of the Larmor frequency of ^{53}Cr on the concentration of the solutions was measured by Fourier transform NMR, and a large solvent isotope effect on the chemical shift of ^{53}Cr was found. Furthermore, the chemical shifts of ^{39}K in potassium chromate were observed, and a ratio of the Larmor frequencies of ^{53}Cr and of ^{39}K was measured with high accuracy in a 2.2 molal solution of K_2CrO_4 in D_2O. Using the concentration dependence of the Larmor frequencies of ^{53}Cr and of ^{39}K, an extrapolated ratio $\nu(^{53}Cr)/\nu(^{39}K)_{extrapol.}$ in infinitely diluted K_2CrO_4 in D_2O is given. From this ratio a value of the magnetic moment of ^{53}Cr in the chromate ion is derived. In chromium hexacarbonyl the ^{53}Cr signal was observed and the chemical shift is given. (DE)

28480 EFFECT OF VIBRATIONS ON THE INTERNAL ROTATION BARRIER IN ETHANE. Kirtman, B.; Palke, W.E.; Ewig, C.S. (Department of Chemistry, University of California, Santa Barbara, California 93106). J. Chem. Phys. 64: No. 5, 1883-1890 (1 Mar 1976).

The effect on the ethane internal rotation barrier of (1) zero-point vibrational averaging and (2) distortions in equilibrium geometry during internal rotation is determined. We find that the (previously ignored) averaging term is 374 ± 90 cal/mole which is substantially larger, and opposite in sign, to the distortion correction of -161 ± 20 cal/mole. The isotope shift, other experimental tests, and some important implications of our results are discussed. (auth)

28481 SPECTRA AND STRUCTURE OF ORGANOPHOSPHORUS COMPOUNDS. XV. MICROWAVE SPECTRUM OF ETHYLPHOSPHINE. Durig, J.R.; Cox, A.W. Jr. (Department of Chemistry, University of South Carolina, Columbia, South Carolina 29208). J. Chem. Phys. 64: No. 5, 1930-1933 (1 Mar 1976).

The microwave spectra of $CH_3CH_2PH_2$, CH_3CH_2PHD, and $CH_3CH_2PD_2$ have been recorded in the range 18.0 to 40.0 GHz. *A*-type transitions were observed and assigned for both *gauche* and *trans* conformers of ethylphosphine, and *b*-type transitions observed and assigned for the *gauche* conformer. The dipole moment components for the *gauche* conformer were determined from the Stark effect to be: $|\mu_a| = 0.86 \pm 0.01$, $|\mu_b| = 0.73 \pm 0.07$, $|\mu_c| = 0.45 \pm 0.05$, and $|\mu_t| = 1.22 \pm 0.07$ D. For the *trans* conformers, there was only one component of the dipole moment and it had a value of $|\mu_a| = |\mu_t| = 1.226 \pm 0.005$ D. The relative intensity of nine pairs of lines for the *gauche* and *trans* were measured at room temperature, and from the ratio of intensities it was found that ethylphosphine exists as a 45% *gauche* and 55% *trans* mixture with an energy difference of 200 ± 100 cm^{-1} and the *trans* the more stable conformer. With reasonable assumptions for the ethyl moiety, the following structural parameters were calculated: $\angle CCP = 110.1 \pm 0.2°$, $r_{PC} = 1.880 \pm 0.0002$ Å and PH_2 dihedral angle = $61 \pm 2°$ and for the *gauche* conformer $\angle CCP = 115.2 \pm 0.2°$, $r_{PC} = 1.876 \pm 0.002$ Å, and PH_2 dihedral angle = $180 \pm 2°$. (auth)

28482 INFRARED SPECTRA OF THE $M^+HBr_2^-$ AND THE M^+HClBr^- ION PAIRS AND THEIR DEUTERIUM ANALOGS ISOLATED IN ARGON MATRICES AT 15 K. Ault, B.S.; Andrews, L. (Department of Chemistry, University of Virginia, Charlottesville, Virginia 22901). J. Chem. Phys. 64: No. 5, 1986-1993 (1 Mar 1976).

The matrix reactions of alkali bromide salts and HBr and DBr have been investigated in argon matrices. In each case, an intense band was observed from the reaction product, which was assigned to the antisymmetric stretch, ν_3, of the HBr_2^- and DBr_2^- anions in the $M^+HBr_2^-$ and $M^+DBr_2^-$ ion pairs. Comparisons to literature spectra, in conjunction with quartic deuterium shifts, indicate that the anion has a linear, centrosymmetric geometry in the isolated ion pair. A less intense band was also observed which has been assigned to the combination band $\nu_1 + \nu_3$ for the HBr_2^- anion. Reaction of alkali bromide salts with HCl and alkali chloride salts with HBr have been shown to yield identical absorptions for the M^+HClBr^- ion pairs. The spectra suggest that both type I and type II $HClBr^-$ anions exist, and the resulting form may be determined by cation position. (auth)

28483 RAMAN ANTIRESONANCE: DE-ENHANCEMENT OF RAMAN INTENSITY BY FORBIDDEN ELECTRONIC

TRANSITIONS. Stein, P.; Miskowski, V.; Woodruff, W.H.; Griffin, J.P.; Werner, K.G.; Gaber, B.P.; Spiro, T.G. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540). J. Chem. Phys. 64: No. 5, 2159-2167 (1 Mar 1976).

The intensities of the Raman lines of the transition metal complexes $Co(en)_3^{3+}$, $PdCl_4^{=}$, $PdBr_4^{=}$, and $PdI_4^{=}$, have been investigated as a function of excitation energy in the vicinity of vibronically allowed ligand field electronic transitions. Whereas resonance enhancement usually results in local maxima in Raman intensities at the energies of allowed electronic transitions, we observe *minima* at the energies of these electronically forbidden transitions. These minima are ascribable to interference between the weak scattering from the forbidden electronic states and strong preresonance scattering from higher energy allowed electronic states. The excitation profiles can be reproduced with a three-state scattering model, using reasonable parameters. (auth)

28484 STRUCTURE OF THE OH STRETCHING VIBRATIONAL BAND OF FORMIC ACID. Wolff, H.; Müller, H.; Wolff, E. (Physikalisch-chemisches Institut, Universität Heidelberg, 69 Heidelberg, West Germany). J. Chem. Phys. 64: No. 5, 2192-2196 (1 Mar 1976).

The infrared spectrum of self-associated HCOOH as well as the infrared spectra of the mixed adducts of HCOOH and DCOOH with acceptors of different basicity are analyzed. Contrary to present interpretations involving the coupling of stretching and intermolecular vibrations, Fermi resonance with overtones and combination tones is proven to be the true and single cause for the submaxima in the OH stretching vibrational range. (auth)

28485 PHOTOCHEMISTRY OF ALKENES. V. [1,3-Sigmatropic Hydrogen Shifts. Kropp, P. J.; Fravel, H. G. Jr.; Fields, T. R. (Univ. of North Carolina, Chapel Hill). J. Am. Chem. Soc.; 98: No. 3, 840-841(4 Feb 1976).

A study was made on the direct light radiation of alkenes which result in positional migration of the double bond with a preference to migrate into a five membered ring where present. Deuterium isotope effect studies indicated intramolecular migration; and it was proposed that the migration was possibly due to emergence of pi, sigma* state as the lowest lying singlet excited state. (DDA)

28486 INFLUENCE OF NEIGHBORING PHENYL PARTICIPATION ON THE alpha-DEUTERIUM ISOTOPE EFFECT ON SOLVOLYSIS RATES. Neophyl Esters. Shiner, V. J. Jr.; Seib, R. C. (Indiana Univ., Bloomington). J. Am. Chem. Soc.; 98: No. 3, 862-864(4 Feb 1976).

The isotope effects of deuterium on substituted neophyl ester solvolysis rates were studied to determine the influence of phenyl participation on isotope effects, and to determine the relationship of transition state structure to solvent, substituent, and leaving group. The alpha-d isotope effects and the solvolysis rates for the acetolysis and trifluoroacetolysis of several neophyl esters were tabulated. It was determined that the isotope effects were lower in reactions where the phenyl ring participated in the rate determining ionization than in reactions where participation was absent. (DDA)

28487 SELF-RADIATION INDUCED EXCHANGE BETWEEN TRITIATED WATER AND ORGANIC COMPOUNDS. The Labelling of L-chiro-Inositol, myo-Inositol, and Hexa-O-methyl-L-chiro-inositol. Fong, D. H. T.; Bodkin, C. L.; Long, M. A.; Garnett, J. L. (Univ. of New South Wales, Kensington). Aust. J. Chem.; 28: No. 9, 1981-1991(Sep 1975).

The stereochemistry of the tritiation of L-chiro-inositol, myo-inositol and hexa-O-methyl-L-chiro-inositol by self-radiation induced exchange with tritiated water of high specific activity has been investigated. Predominance of configurational retention was found to accompany tritium labelling in the two inositols, while substantial configurational inversion occurred in the hexa-O-methyl derivative. Tritiation occurred predominantly at C1 in L-chiro-inositol, with slight inversion at this position alone accompanying the labelling. Comparison with Wilzbach T_2 gas exposure results indicates the HTO method yields less by-products, myo-inositol having a radiochemical purity of 97%. (auth)

28488 FUGACITIES OF THE COMPONENTS OF FUSED LITHIUM CHLORIDE–THORIUM TETRACHLORIDE MIXTURES. Smirnov, M. V.; Khudolozhkin, V. N.; Kudyakov, V. Ya. (Inst. of Electrochemistry, Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 6, 822-824(Jun 1975).

Translated from Zh. Fiz. Khim.; 49: No. 6, 1393-1395(Jun 1975).

The fugacities of the components in LiCl–$ThCl_4$ mixtures containing between 0 and 50 mole % $ThCl_4$ have been determined for the saturated vapor between 690 and 930°C. The experimental results make it possible to estimate the variation of the thorium content in the sublimates as a function of the composition of the melt. (auth)

28489 KINETIC ISOTOPIC EFFECT IN THE HETEROGENEOUS ATOMIZATION OF HYDROGEN ON TUNGSTEN. Kislyuk, M. U. (Inst. of Chemical Physics, Moscow). Bull. Acad. Sci. USSR, Div. Chem. Sci.; 24: No. 2, 212-214(Feb 1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 24: No. 2, 273-276(Feb 1975).

The basic contribution to the kinetic isotopic effect in the case of atomization of hydrogen is made by the difference of the bond strengths in the molecules of hydrogen and deuterium. The activated complex of the process of desorption of atoms from the surface of tungsten possesses substantial liability. (auth)

28490 α-DEUTERIUM ISOTOPE EFFECTS ON THE IONIZATION OF WEAK ACIDS. Bron, J. (Natal Univ., Durban, South Africa). J. Chem. Soc. (London), Faraday Trans., II; 71: No. 10, 1772-1776(1975).

The deuterium equilibrium isotope effect, K_H/K_D, for the ionization of acetic acid is used as an example to demonstrate that the theory of statistical thermodynamics can give an explanation of the observed trends in K_H/K_D for various weak acids. By changing the diagonal force constants of the reacting species, an impression can be obtained of the origin of isotope effects in these reactions. The value of K_H/K_D is also computed and it is predicted that CT_3COOH is a weaker acid than CD_3COOH. (auth)

28491 HEAVY-ATOM KINETIC ISOTOPE EFFECTS. Maccoll, A. (University Coll., London). Annu. Rep. Prog. Chem., Sect. A; 71: 77-101(1974).

A general account of the theory and practice of the technique is given, with key references. This is followed by a section on experimental methods and on the interpretations of the experimental results. Finally, an account is given of applications of the method in the cases of carbon, nitrogen, oxygen, sulfur and chlorine. (UK)

28492 ISOTOPIC FRACTIONATION IN SOLIDS. McLachlan, L. A. (Inst. of Nuclear Sciences, Lower Hutt, New Zealand). N. Z. J. Sci.; 17: 219-232(1974).

Using the Born–von Karman lattice model and thermodynamic perturbation theory, an expression is derived for the isotopic fractionation factor of two solids in thermodynamic equilibrium. The limitations and interrelationships of the various methods of calculating isotopic fractionation ratios for solids are also given and the reliability of using calculated isotopic fractionation factors for the determination of mineral deposition temperatures is discussed. (auth)

28493 ISOTOPE EFFECT IN THE OXIDATION OF HYDROGEN ON PLATINUM. Balovnev, Yu. A. Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 8, 1237-1238(Aug 1975).

Translated from Zh. Fiz. Khim.; 49: No. 8, 2112-2113(Aug 1975).

The isotope effects in the oxidation of hydrogen on platinum were measured for different compositions of the reaction mixtures. The observed dependence of the isotope effect on composition was explained by the change in the number of collisions with the surface when hydrogen is replaced by deuterium. (auth)

28494 STUDY OF THE ROTATIONAL SPECTRUM OF THE MOLECULES HCOOH, DCOOH, HCOOD, AND DCOOD IN THE SUBMILLIMETER REGION. Baskakov, O. I.; Moskienko, M. V.; Dyubko, S. F. Zh. Prikl. Spektrosk.; 23: No. 4, 692-695(Oct 1975). (In Russian)

In investigating the rotational spectrum of the formic acid molecule a radiospectrometer was used with videodetection of the absorption signal and hetereodyne measurement of the frequency. About 400 lines were measured and identified that corresponded to rotational transitions of the type $R_a(\Delta) = 1$, $\Delta k_{-1} = 0$) for the molecules HCOOH, DCOOH, HCOOD and DCOOD in the submillimeter region (up to 690 Ghertz) with an accuracy of ±0.2 Mhertz. From these frequencies with the use of the theory of Watson, calculations were made of the rotational constants A, B, and C, and the centrifugal constants of the fourth and sixth degree. (SJR)

28495 RAMAN SPECTRUM OF ICE VIII. Wong, P.T.T.; Whalley, E. (Division of Chemistry, National Research Council, Ottawa K1A 0R9, Canada). J. Chem. Phys. 64: No. 6, 2359-2366 (15 Mar 1976).

The Raman spectra of H_2O and D_2O ice VIII recovered at ~100 K and zero pressure have been measured in the range 4000–50 cm^{-1}. The three stretching, three rotational, and four translational bands expected from the symmetry of the crystal have been identified. Two bending bands are expected and have been tentatively identified among some weak bands. The relative intensity of the rotational and stretching bands is much smaller than in the vapor, and so if the intensity of the stretching bands is not greatly changed, the anisotropy of the polarizability is appreciably smaller in ice VIII than in the vapor. (auth)

28496 SPECTROSCOPIC STUDIES OF DIATOMIC NOBLE GAS HALIDES: ANALYSIS OF SPONTANEOUS AND STIMULATED EMISSION FROM XeCl. Tellinghuisen, J. (Department of Chemistry, Vanderbilt University, Nashville, Tennessee 37235); Hoffman, J.M.; Tisone, G.C.; Hays, A.K. J. Chem. Phys. 64: No. 6, 2484-2490 (15 Mar 1976).

A XeCl emission band system with peak intensity near 3080 Å is reported and analyzed. The vibrational analysis of this spectrum includes 24 violet-degraded bands assigned to $Xe^{35}Cl$ and $Xe^{37}Cl$, and yields (for $Xe^{35}Cl$) $\Delta T_e = 32\,405$ cm^{-1}, $\omega_{e'} = 195.2$ cm^{-1}, $\omega_{e'} x_{e'} = 26.3$ cm^{-1}, and $D_{e'} = 255$ cm^{-1}. The weakly bound $^2\Sigma^+$ ground state of XeCl resembles a van der Waals state, whereas the excited state is the analog of the CsCl ground state. Approximate potential curves are derived for these XeCl states. Lasing is observed on the 0–1, 0–2, and 0–3 bands of this transition, with a peak output power of 1.5×10^4 W. (auth)

28497 DEUTERIUM SHIFTS IN THE HIGH RESOLUTION PHOTOELECTRON SPECTRA OF ACETALDEHYDE. Cvitaš, T.; Güsten, H. (Kernforschungszentrum Karlsruhe, Institut für Radiochemie, 75 Karlsruhe, Federal Republic of Germany); Klasinc, L. J. Chem. Phys. 64: No. 6, 2549-2551 (15 Mar 1976).

By comparing the high-resolution photoelectron spectra of acetaldehyde and three of its deuterated derivatives (CH_3CDO, CD_3CHO, and CD_3CDO) in the first system ($\tilde{X}$), the assignment of six vibrational modes in the ground state of the acetaldehyde ion was possible. The vibronic structure of this system is very sensitive to deuteration of the CH_3 or CHO group, showing that the active vibrations include complex motions of all the hydrogen atoms in acetaldehyde. The most prominent vibrations are the CH bending and CH_3 deformation modes which reveal that the oxygen lone pair electrons play an important role in determining the bond angles in the acetaldehyde ion. (auth)

28498 ISOTOPE EFFECTS IN SUPERIONIC CONDUCTORS. Kimball, J.C.; Eswaran, M. (Department of Physics and Asdtronomy, Louisiana State University, Baton Rouge, Louisiana 70803). J. Chem. Phys. 64: No. 7, 2711-2714 (1 Apr 1976).

A quantum mechanical calculation of the conductivity of a simple model of a superionic conductor which considers short range interactions between the mobile ions is presented. This model yields results which depend strongly on the nuclear spin on the mobile ion. In principle, this isotope dependent conductivity could lead to isotope separation. In practice, ignored interactions between the mobile ions and the nonmobile ions in the lattice could mask this effect. (auth)

28499 AN ELECTRON PARAMAGNETIC RESONANCE STUDY OF METHYLENE. Bernheim, R.A.; Adl, T.; Bernard, H.W.; Songco, A.; Wang, P.S.; Wang, R.; Wood, L.S.; Skell, P.S. (Davey Laboratory, Department of Chemistry, The Pennsylvania State University, University Park, Pennsylvania 16802). J. Chem. Phys. 64: No. 7, 2747-2755 (1 Apr 1976).

The present paper is a detailed account of the study of the methylene molecule trapped in matrices at 4.2 °K by electron paramagnetic resonance spectroscopy. The methylene is generated by photolysis of its diazirine precursor dissolved in the matrix material. Besides verifying that the methylene ground electronic state was a spin triplet, the first observation of the EPR spectrum revealed that the molecule was nonlinear. Through assumptions concerning the amounts of spectral averaging owing to molecular motion and the relationship of the zero-field splitting parameters D and E with each other through an s–p hybrid model of the electronic structure, other workers showed the bond angle to be substantially bent. This was later confirmed by ourselves and others with a measurement of the isotropic carbon-13 hyperfine interaction. Using 90.5% carbon-13 enrichment in the present work, a more precise determination of the isotropic carbon-13 hyperfine interaction was found to be 239 MHz. The increased resolution also permits a measurement of the anisotropic carbon-13 hyperfine interaction from which a bond angle of 134° can be derived. All three methods of bond angle determination are in substantial agreement. Chemical trapping of the products of the photolysis with a 100% mass balance accounting for all substances supplement the EPR of the isotopically substituted species to show conclusively that the trapped paramagnetic species is methylene. Experiments in a nonnuclear magnetic matrix show that the linewidths are not due to hyperfine interactions with matrix nuclei. In addition to xenon matrices, experiments in krypton and xenon–krypton mixtures are reported where the observed zero-field splitting parameters are modified by molecular motion and interaction with the trapping matrix. The present work also verifies that the heat of formation of methylene is 91.9±1.0 kcal/mole. (auth)

28500 A COLLINEAR ANALYTIC MODEL FOR ATOM–DIATOM CHEMICAL REACTIONS. Halsivee, U. (Department of Applied Optics, Soreq Nuclear Center, Yavne, Israel); Shapiro, M. J. Chem. Phys. 64: No. 7, 2826-2839 (1 Apr 1976).

A collinear analytic model for atom–diatom chemical reactions is developed in a systematic fashion from the exact quantum mechanical formulas. All the approximations involved were outlined and their range of validity indicated. The products' vibrational distributions of 12 chemical reactions as well as isotope effects were calculated and shown to agree well with numerical collinear calculations, experimental results, and classical trajectory studies (when available). The factors influencing a reaction's outcome were analyzed and the mass and isotope effects extensively explored; two types of behavior corresponding to the light atom and heavy atom regions were quantitatively mapped. It is hoped that similar results can be obtained from this model via spectroscopic data of the separate diatomics without ever having to precalculate a triatomic potential surface. (auth)

28501 ^{13}C KINETIC ISOTOPE EFFECTS IN THE PYROLYSIS OF DIMETHYL ETHER. Zielinski, M.; Kidd, R.W.; Yankwich, P.E. (Department of Chemistry, University of Illinois, Urbana, Illinois 61801). J. Chem. Phys. 64: No. 7, 2868-2877 (1 Apr 1976).

Intermolecular and intramolecular ^{13}C kinetic isotope effects in the pyrolysis of dimethyl ether were measured at temperatures between 451 and 550 °C; initial pressures were between 14 and 1000 torr. A few experiments on the NO-inhibited reaction were carried out at 501 °C. Both isotope effects are of the order of 1% and decrease with increasing temperature; the temperature dependence of the intermolecular effect is the greater. No significant pressure effects were observed. The isotope effects arise in the destruction of the symmetry of the reactant in hydrogen transfer reactions of the form $R + C^2H_3OC^1H_3 \rightarrow RH + C^2H_2OC^1H_3$, where $R = CH_3$, H, or NO. The method of three-element reaction coordinates was used to model the hydrogen transfer, the elements being displacements in the stretching coordinates R···H, H···C^2, and C^2=O. With adjustments of the transition state diagonal force field which are physically and chemically reasonable, the best simultaneous fit to the experimental results is obtained for reaction coordinates in which displacements in R···H and H···C^2 are large but that in C^2=O is small. The fit is not critically sensitive to the degree of transfer of H from C^2 to R in the range 25%–75%, and in that range is essentially the same for R = H, CH_3, or NO. Predictions are made of k_H/k_D for comparative pyrolyses of CH_3OCH_3 and CD_3OCD_3. (auth)

28502 THE FS CORRELATION AND A SYSTEMATIC ANALYSIS OF THE STRETCHING ABSORPTIONS OF WATER IN THE CONDENSED STATE. Schiffer, J.; Intenzo, M.; Hayward, P.; Calabrese, C. (Department of Chemistry, Temple University of the Commonwealth System of Higher Education, Philadelphia, Pennsylvania 19122). J. Chem. Phys. 64: No. 7, 3014-3020 (1 Apr 1976).

The separation between uncoupled ν_3 and ν_1 frequencies of water symmetrically bound in both nonaqueous solvents and hydrates has been shown to vary linearly with the HOD stretching frequency of water, for both H_2O and D_2O. This relation, the FS correlation, has been explored theoretically and it has been shown to be useful for estimating geometry changes of water in hydrates, upon deuteration. It is also useful in determining the effect of cation coordination on the stretching frequencies of water molecules. A method is also developed, using this relation, for systematically analyzing the origin of the stretching bands of water in condensed systems. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 31194.

28503 ISOTOPIC EXCHANGE REACTIONS BETWEEN SODIUM CHLORIDE AND BENZYL CHLORIDES IN MIXED SOLVENTS. El-Atrash, A. M.; El-Shethary, B. A. (Ain Shams Univ., Cairo (Egypt)). J. Prakt. Chem.; 319: No. 6, 1041-1046(1974).

Isotopic exchange reactions between a number of benzyl chlorides and sodium chloride labeled with radioactive ^{36}Cl were investigated in mixed solvents. The benzyl chlorides used are: benzyl chloride 1, o-nitrobenzyl chloride 2, m-nitrobenzyl chloride 3, and p-nitrobenzyl chloride 4. The mixed solvents are: 90% ethanol-10% water and 80% dioxane-20% water by weight. (INIS)

28504 NEW LASER PHOTOCHEMICAL PROCESS FOR ISOTOPE ENRICHMENT. Lin, C. T. (Universidade Estadual de Campinas, Brazil). Spectrosc. Lett.; 8: No. 11, 901-913(1975).

Selective laser excitation of a specific isotopic species to its lowest electronic singlet (S_1) and triplet (T_1) states respectively, then followed by a chemical reaction for isotope separation, is examined theoretically. It is found that the direct excitation to T_1 state from ground state (S_0) is an unique excitation channel for obtaining a controllable chemical reaction and for achieving a high isotope separation factor. This is due to the following important facts: (1) resonant energy transfer from a selectively excited triplet isotopic species to an unexcited species of the other isotope present in the mixture is missing (or is very small); (2) the lifetime of the T_1 state is normally longer than that of the S_1 state; (3) there is no intersystem crossing channel that exists for the deactivation of excited isotopic species from T_1 state. Numerical calculation is performed for the chlorine isotope separation in a mixture of thiophosgene (0.5 torr) and diethoxy-

ethylene (1.5 torr). The result indicates that the isotopic enrichment factor is at least 2.5 x 10^3 times larger for selective T_1 excitation than that for S_1 excitation. (auth)

28505 BASE-CATALYZED ISOTOPIC EXCHANGE OF MOLECULAR HYDROGEN. III. Transition-State vs Initial-State Solvation in the Dimethyl Sulfoxide–Water System. Buncel, E.; Symons, E. A. (Queen's Univ., Kingston, Ont.). J. Am. Chem. Soc.; 98: No. 3, 656-660(4 Feb 1976).

The kinetics of isotopic exchange between D_2 and H_2O under catalysis by OH^- have been determined in dimethyl sulfoxide-water mixtures as a function of temperature. Activation parameters have been derived. It is found that (DELTA enthalpy) decreases by 7 kcal/mole over the range 0 to 50 mole percent Me_2SO and then rises slightly. (DELTA entropy) passes through a minimum near 60 mole percent Me_2SO. As a result (DELTA free energy) decreases only moderately (3.5 kcal/mole) over the full range of medium composition. Transition-state enthalpies of transfer, delta DELTA H/sub tr//sup t/, from water to aqueous Me_2SO, have been evaluated using the enthalpies of activation and the known enthalpies of transfer of OH^- and D_2. The delta DELTA H /sub tr//sup t/ term is endothermic throughout the range of solvent composition; for 96.9 mole percent Me_2SO, delta DELTA H /sub tr//sup t/ is 13.7 kcal/mole compared with a value of 17.5 kcal/mole compared with a value of 17.5 kcal/mole for hydroxide ion. This points to a transition-state structure with considerable charge localization on oxygen, resulting in transition-state desolvation in Me_2SO-rich media. This conclusion allows certain mechanisms for the D_2-OH^- exchange to be excluded. Currently favored are a mechanism in which an H_2O molecule participates in the rate-determining step, providing electrophilic assistance for removal of D^- during attack by HO^- on D_2, and one involving rate-determining replacement of an H_2O of solvation from hydroxide ion by D_2 followed by rapid isotopic exchange. (auth)

28506 KINETICS OF HYDROGEN ISOTOPE EXCHANGE REACTIONS. XXVIII. Steric Course of Radiation-Induced Tritium Exchange Between Water and Cyclohexane-1,2-Diols. Garvey, J. P.; Gold, V.; McAdam, M. E.; Cooper, A. (Kings Coll., London). Proc. R. Soc. (London), Ser. A; 346: No. 1647, 427-441(25 Nov 1975).

Under the influence of tritium β-radiation, dissolved trans-cyclohexane-1,2-diol exchanges carbon-bound hydrogen with the solvent (tritiated water). The exchange occurs not only at the hydroxyl-substituted (α) carbon atoms but also at non-α positions, which are, on the average, less reactive. The overall G-value for exchange in all positions is about 0.33. With γ-irradiation, exchange takes place with a slightly lower overall G-value. Exchange at α-positions occurs with predominant retention of configuration (76%). In the corresponding α-exchange of cis-cyclohexane-1,2-diol, 79% of the reaction proceeds with inversion, i.e., the labelled products are in both reactions formed in practically the same ratio. It is concluded that the reactions go through a common intermediate (or rapidly equilibrating common set of intermediates), for both diols as substrates. (auth)

28507 KINETICS OF HYDROGEN ISOTOPE EXCHANGE REACTIONS. XXIX. Radiation-Induced Tritiation of 1,4-Dioxane in Aqueous Solutions. Gold, V.; McAdam, M. E. (Kings Coll., London). Proc. R. Soc. (London), Ser. A; 346: No. 1647, 443-467 (25 Nov 1975).

Under the influence of tritium β-radiation, 1,4-dioxane undergoes hydrogen exchange with the solvent water. The inhibition of the reaction by known electron scavengers (Ag^+, Cu^{2+}, Ni^{2+}, Co^{2+}, Zn^{2+}, H_3^+O) and also by species with high reactivity towards hydroxyl radicals but negligible reactivity towards solvated electrons (N_3^-, Br^-, SCN^-) has been examined in detail. Gamma-irradiation similarly induces hydrogen exchange. The action of scavengers is interpreted as requiring the involvement of two separately scavengeable primary radiolysis products in the sequence of reactions leading to exchange. The presence of electron scavengers, even at high concentration, does not totally inhibit the exchange, and a secondary exchange route, involving a lower valency state of inhibitor cations, is considered responsible for the "unscavengeable" portion of the reaction, by providing an alternative exchange route. Analogies are drawn between the exchange reaction and other radiation-induced reactions that are thought to involve spur processes. Some implications of the present results for the interpretation of radiation-chemical studies in water-alcohol mixtures are indicated. (auth)

28508 OXIDATIVE ADDITION OF HYDROHALIC ACIDS TO DIMOLYBDENUM(II) SPECIES. Reformulation of $Mo_2X_8^{3-}$ as $Mo_2X_8H^{3-}$. Cotton, F. A.; Kalbacher, B. J. (Texas A and M Univ., College Station). Inorg. Chem.; 15: No. 3, 522-524 (Mar 1976).

Several years ago a series of compounds thought to have the general formula M/sup I/$_3Mo_2X_8$ (M/sup I/ equals K, Rb, Cs; X equals Cl, Br) was reported, and the structures of the binuclear anions were described as confacial bioctahedra with one-third of the bridging halogen atoms missing or, alternatively, as pairs of square pyramids sharing a basal edge. Evidence is now presented that these anions are in fact $Mo_2X_8H^{3-}$ ions with bridging hydrogen atoms and that they result from oxidative addition of HX to intermediates such as $Mo_2X_7(H_2O)^{3-}$. The compounds are diamagnetic. In the case of the chloro species, tritium labeling has demonstrated the presence of the H atoms and the reactions of $Mo_2X_8H^{3-}$ with D^+ or Mo_2X_8D with H^+ generate HD. There is also infrared evidence for the presence of the bridging hydrogen atoms. (auth)

28509 KINETIC ANALYSIS OF ACTIVE MEMBRANE TRANSPORT SYSTEMS: EQUATIONS FOR NET VELOCITY AND ISOTOPE EXCHANGE. Cuppoletti, J.; Segel, I. H. (Univ. of California, Davis). J. Theor. Biol.; 53: No. 1, 125-144(1975).

Equations for the initial net velocity and for isotope exchange velocities in active membrane transport systems are presented. The equations are expressed entirely in terms of kinetic constants which are experimentally determinable from appropriate reciprocal plots, and replots of slope and intercept (for net velocity) or $1/\Delta$ slope and $1/\Delta$ intercept (for isotope exchange). The equations and plots are equally applicable to a soluble isoenzyme system. The effect of pH on sulfate transport by an ATP-sulfurylase negative mutant of Penicillium notatum was analyzed assuming that $^{35}SO_4^{2-}$ and H^+ are cosubstrates of the transport system. The kinetics are consistent with an ordered addition to the carrier of one H^+ ion followed by $^{35}SO_4^{2-}$, with H^+ in equilibrium with the carrier and the carrier-H^+ complex. (auth)

28510 KINETICS OF ^{18}O EXCHANGE BETWEEN CARBOXYLIC ACIDS AND WATER. Redington, R. L. (Texas Tech. Univ., Lubbock). J. Phys. Chem.; 80: No. 3, 229-235(29 Jan 1976).

Using the example of trifluoroacetic acid, infrared matrix-isolation spectroscopy is shown to provide an analytical method for monitoring the oxygen exchange kinetics that occur in solutions of carboxylic acids and water. The method should prove valuable in cases where locating specific ^{18}O labels is important. The spectra demonstrate that the singly ^{18}O-labeled acid molecules are generated at equal rates on a macroscopic time scale. The rate equation is followed over large changes of the ^{18}O label for both acid and water molecules. The samples, highly concentrated in CF_3COOH, possess approximately equimolar amounts of ^{16}O and ^{18}O. Deuteration (50 percent) reduces the specific rate constant by approximately 30 percent. Literature data for the oxygen exchange kinetics of CF_3COOH, CCl_3COOH, CH_3COOH, and $C(CH_3)_3COOH$ are reexamined and the rate constants and exchange pathways are discussed. In acidic solutions it appears that the primary exchange pathway is by direct attack of hydronium ion on the neutral acid molecule. The rate constants determined using matrix-isolation spectroscopy are similar to those obtained using mass spectrometric analysis. (auth)

28511 PRODUCTION OF ^{13}C BY CHEMICAL EXCHANGE REACTION BETWEEN AMINE CARBAMATE AND CARBON DIOXIDE IN A SOLVENT-CARRIER SYSTEM. Ghate, M. R.; Taylor, T. I. (Columbia Univ., New York, NY). Sep. Sci.; 10: No. 5, 547-569(1975).

The chemical exchange reaction between amine carbamate and CO_2 has been investigated for the purpose of using it as a practical method to concentrate ^{13}C. The effects of solvent, concentration of amines, catalysts, flow rate, and diameter of the column have been studied for a number of amines. Of the solutions studied, di-n-butylamine (DNBA) in triethylamine (TEA) as a solvent proved to be the most favorable for use in the preparation of highly enriched ^{13}C. The overall separations obtained as a function of the concentration of DNBA using 2.5 cm i.d. x 100 cm column ranged from 2.05 at 1 M to 1.69 at 2.84 M. For 2 M DNBA the maximum separation was 1.94. At this concentration of DNBA the overall separation as a function of flow rate ranged from 1.94 at 0.845 ml/cm^2-min to 1.31 at 2.9 ml/cm^2-min. Neither the rate of exchange nor the overall separations were improved by use of catalysts. Increasing the diameter twofold resulted in little or no loss in overall separations. On the basis of the properties of the system and the data obtained with respect to the above variables, design calculations were made for a six-stage tapered cascade. These calculations were based on a flow of 40 ml/min of 2 M DNBA in TEA, giving a maximum transport of 7.1 x 10^{-3} mmole/min or a maximum production rate of 130 mg ^{13}C/day. The cascade was operated for about about 5 months during which period gram quantities of 67 percent ^{13}C were produced. (auth)

28512 FORMATION OF HYDROXYL GROUPS AND EXCHANGE WITH DEUTERIUM ON NaHX AND NaHY ZEOLITES. Kubelkova, L.; Novakova, J. (Inst. of Physical Chemistry and Electrochemistry, Prague). Collect. Czech. Chem. Commun.; 41: No. 2, 325-336(Feb 1976).

The deammoniation and dehydroxylation of $Na(NH_4)X$ and $Na(NH_4)Y$ zeolites were compared. With the X type, both processes overlap and proceed more easily than with the Y type. Both H forms contain structural OH groups and hydroxyls denoted as SiOH, to which a 3740 cm^{-1} band in the IR spectrum is assigned. The zeolite NaHX contains, in addition, OH groups characterized by 3700 and 3600 cm^{-1} bands. Certain differences in the behaviour of NaHX and NaHY zeolites during deammoniation and dehydroxylation can be attributed to the presence of "non-localizable" H atoms. Active sites for the D_2-OH exchange are formed probably during dehydroxylation. Hydrogen in SiOH groups is replaced by deuterium with both zeolite types more slowly than H atoms of other OH groups, which influences the kinetic dependences in the gas phase. The presence of water in the gas phase influences the kinetics and can distort the determination of the number of H atoms bound in the zeolites. (auth)

28513 ISOTOPE CONCENTRATION. Thayer, V. R. Canadian Patent 916402. 12 Dec 1972. 28p.

Available from Commissioner of Patents, Ottawa.

The method and apparatus disclosed relate to the production of a concentrate of an isotope of an element by chemically exchanging at different temperatures isotopes of the same element between chemically different fluids which are physically separable from each other and which are capable of containing each of the isotopes. According to the method, both heat and isotopes are exchanged between the fluids simultaneously while the fluids are flowing counter-currently with respect to each other within a temperature gradient. Conduits positioned within an exchange tower recirculate one or both of the fluids to permit simultaneous direct and indirect heat exchange as well as isotope exchange between the fluids. (auth)

28514 PROCESS AND APPARATUS FOR ENRICHMENT BY COUNTER-CURRENT MASS TRANSFER. Thayer, V. R. Canadian Patent 924080. 10 Apr 1973. 26p.

Available from Commissioner of Patents, Ottawa.

A chemical compound, element or isotope of an element is concentrated or enriched by physical or chemical exchange between two fluids passing countercurrently to each other in a plurality of concentrating units (vessels or towers). Each of the vessels is capable of operating independently. A feed fluid is supplied simultaneously to each of the units which concentrate and enrich it. The degree of enrichment occurring in a particular vessel depends upon the physical length of the particular vessel. The enriched products produced in the shorter vessels are fed, in contradistinction to prior art processes, to the longer vessels for further concentration. The process may be operated continuously regardless of the shut-down of one or more of the individual vessels utilized in the process. (auth)

28515 HOMOGENEOUS CATALYSIS OF HYDROGEN ISOTOPE EXCHANGE BETWEEN D_2 AND ETHANOL BY DICHLOROTRIS (TRIPHENYLPHOSPHINE) RUTHENIUM(II). Strathdee, G.; Given, R. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Can. J. Chem.; 53: No. 10, 1402-1409(15 May 1975).

20 refs. Also issued as report no. AECL-5061.

Rates of D_2-ethanol exchange catalyzed by solutions of dichlorotris(triphenylphosphine) ruthenium(II) in 1:1 benzene–ethanol are reported as a function of the concentrations of ruthenium, deuterium, triphenylphosphine, and HCl. The rates were extremely fast. Over the temperature range 263 to 303°K, the apparent activation energy was 85 kJ/mol. The kinetics have been interpreted in terms of a mechanism in which activation of D_2 by $RuCl_2L_3$ is rate-controlling. A comparison is made between the characteristics of this homogeneous catalyst and those of the related $RbClL_3$. (auth)

28516 HIGH FREQUENCY IONOPHORESIS STUDY OF THE HYDROLYSIS OF TRITHIONATE AND TETRATHIONATE. Wagner, H.; Schreier, H. (Univ. de Saarlandes, Saarbruecken, Ger.). J. Radioanal. Chem.; 29: No. 1, 5-14(1976). (In German)

Outer and inner ^{35}S-labelled $S_2O_3^{2-}$ and $S_4O_6^{2-}$ are prepared and then hydrolyzed at different temperatures. The separation of the reaction mixture is made by high-voltage paper ionophoresis. The amount of activity is determined directly on the paper by liquid scintillation. The ratios of activity of the reaction products are compared with those calculated on the basis of three different reaction mechanisms. All experimental results agree very well with the authors' proposed reaction via the unsymmetrical intermediate $^-O_3S-SOH$. The influence of the isotope exchange between $S_2O_3^{2-}$ and SO_3^{2-} on the ratio of activity is examined at different temperatures. Attempts have been made also to capture the SO_3^{2-} which originates from the first step of the $S_4O_6^{2-}$ decomposition. (auth)

28517 $^{14}N_2-^{14}N^{15}N$ ISOTOPE SEPARATION FACTORS IN THE LOW-TEMPERATURE ADSORPTION OF NITROGEN ON CaA ZEOLITE. Sarukhanov, A. V.; Zel'venskii, Ya. D.; Kochurikhin, V. E.; Danil'chenko, G. F.; Ozheredov, V. M. (Moscow Inst. of Chemical Engineering). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 8, 1234-1236(Aug 1975).

Translated from Zh. Fiz. Khim.; 49: No. 8, 2108-2110(Aug 1975).

The $^{14}N_2-^{14}N^{15}N$ isotope separation factors in the adsorption of nitrogen on CaA zeolite at 78 K and in the range 30 to 720 torr were measured on a vacuum circulation apparatus by the single isotope equilibration method. The value of α obtained was checked by an independent method–from the time variation of the degree of separation of nitrogen isotopes attained in the separating section of a laboratory continuous counter-current adsorption column during the non-steady-state period of its operation. (auth)

Feed Materials Processing

Refer also to abstract 29080.

28518 (INIS-mf-1853) UCAN 1973 ANNUAL REPORT. MacNabb, G. M. (Uranium Canada Ltd., Ottawa, Ontario). Dec 1974. 14p. (In French and English). INIS.

A financial statement and details on the management of the joint uranium stockpile are given for Uranium Canada Ltd. for the year ended Dec. 31, 1973. (ECB)

28519 ION EXCHANGE: PRINCIPLES AND APPLICATIONS. Bank, N.; Majumdar, A. S. (Mcgill Univ., Montreal (Canada). Dept. of Chemical Engineering). J. Inst. Eng. (India), Chem, Eng. Div.; 55: No. pt. CH2, 44-48(Feb 1975).

An attempt is made to provide a brief state-of-the-art review of the basic principles underlying the unit operation of ion exchange and its numerous and diverse commercial applications. A selective bibliography is provided for the benefit of the reader interested in pursuing any specific aspect of ion exchange. (auth)

28520 ENVIRONMENTAL ASPECTS OF URANIUM EXTRACTION. Lackey, J. A. AMDEL (Aust. Miner. Dev. Lab.) Bull.; No. 15, 11-20(Apr 1975).

In the seventies, processing facilities will be constructed in Australia for the chemical extraction of uranium from its ores and it is expected that fairly stringent controls will be placed on the quality and quantity of effluents from the plants. This paper describes the effluents produced from the processing of uranium ores by the acid leaching route and the methods of waste treatment that are available to the design engineer. (auth)

28521 IMPROVEMENTS IN OR RELATING TO GELATION. Simpson, M. R.; Stockwell, C. L. British Patent 1,401,962. 6 Aug 1975. Filed date 24 June 1971. 4p.

Reference is made to apparatus and methods for the production of gel spheres. Such spheres are produced by contacting feed material, in the form of droplets with a gelling reagent, and the processes involved are particularly applicable to nuclear fuels. In conventional processes the droplets pass through a gaseous reagent, in which the gelation reaction commences, and then contact the surface of a liquid reagent where the reaction continues to completion. A disadvantage that arises is that malformed gel products may be produced if the droplets, partially gelled by the gaseous reagent, are not sufficiently hard to be capable of passing to the second stage without undergoing substantial deformation. The apparatus and process described are aimed at substantially overcoming this disadvantage, the droplets being prevented from contacting the surface of the liquid reagent at a velocity sufficient to disrupt or distort them, this being accomplished by use of a layer of foam above the surface of the liquid reagent. (UK)

Radiation Chemistry

Refer also to abstracts 28436, 28506, 28507, 29533, 29534, 29630, 30107, 30284, 30292–30294, 30304, 30306, 30345–30349, 30373, 30374, 31055, and 31958.

28522 (CTOM-16567) RADIATION CHEMISTRY OF POLYSTYRENE AND STYRENEBUTADIENE COPOLYMER. Chau, T. C. (Waterloo Univ., Ontario (Canada)). 1973. 159p. INIS.

Thesis. Available on microfilm from the National Library of Canada, Ottawa, order No. 16567.

28523 (INIS-mf-1921) ROLE OF RADIATION TECHNOLOGY IN CHEMICAL PROCESSING. Du Plesses, T. A. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Radiation Chemistry Div.). 1975. 11p. INIS.

From Oil and Color Chemists' Association Meeting; Pelindaba, Pretoria, South Africa (17 Jul 1975).

In any material exposed to high-energy ionizing radiation, charged species (ions), radicals and excited states are produced—all of which are chemically very reactive. Radiation is not unique, inasmuch as these intermediates can be produced by certain

chemical reagents or by other techniques. However, radiation does allow an almost perfect external control to be exercised throughout a wide range of conditions. The more important industrial applications involve the modification of both synthetic and natural polymers, polymerization of monomers under various conditions and the manufacture of certain chemicals. For the purpose of this paper, the discussion is confined to economically viable processes which are commercial realities or which are being developed as future industrial applications, and the activities in South Africa in these fields are pointed out.

28524 (JAERI-M-6083) SIMULTANEOUS STABILIZATION-POLYMERIZATION OF TETRAOXANE. II. Nakase, Y. (Japan Atomic Energy Research Inst., Takasaki, Gunma. Takasaki Radiation Chemistry Research Establishment). Mar 1975. 34p. (In Japanese). Dep. NTIS (US Sales Only) $5.00.

Investigation of the simultaneous stabilization polymerization of tetraoxane to obtain thermally stable polyoxymethylene is described as a subsequent report of JAERI-M 5895. Carboxylic acid anhydrides and compounds containing a sulfur atom substituted for an oxygen atom of cyclic acetal are found to be effective. It is reasonably explained that the former acts as a chain transfer agent and the latter acts as a comonomer. In polymerization of tetraoxane in the presence of the comonomer mentioned, the results differ from those in the presence of cyclic acetal reported previously; polymer yield and also thermal stability of the polymer obtained are higher in the presence of oxygen than in the absence, and radiation-induced polymerization occurs in the liquid state with low polymerization rate, since the radiation-induced polymerization possibly occurs only in the solid state. Search for a new simultaneous stabilization-polymerization process is attempted, using several different chain transfer reagents and comonomers such as heterocyclic compounds. These results are also presented. Some substances, thiirane for example, are found to be useful for the above process. (auth)

28525 CHEMICAL TRANSFORMATIONS OF TETRAFLUOROETHYLENE COPOLYMER WITH ETHYLENE DURING RADIOLYSIS IN VACUUM. Bol'shakova, N. I.; Tikhomirova, N. S.; Serenkov, V. I.; Zalkind, G. I.; Pridatchina, N. N. (Nauchno-Issledovatel'skij Inst. Plasticheskikh Mass, Moscow (USSR)). Vysokomol. Soedin., Ser. A; 16: No. 8, 1913-1918(Aug 1974). (In Russian)

For English translation see the journal Polym. Sci.

Infrared spectroscopic studies of γ-irradiation (in a vacuum) of a tetrafluoroethylene-ethylene (1 : 1) copolymer showed changes in the chemical structure which depended on the irradiation conditions. With increase in dose the intensity of the absorption band in the 1450- and 2973-cm^{-1} region, corresponding to oscillation of the CH_2 group, and a series of absorption bands in the 500- to 1300-cm^{-1} region, corresponding to valence and deformation oscillations of the C-F bond of the CF_2 group, decreased. These changes increased with increase in irradiation temperature from 25 to 250°C. A different type of double bond appeared: –CH = CF–, –CF = CF, and –CH = CF_2 (bands at 1720, 1740, and 1765, respectively). The intensity of the absorption band in the region of 1740 cm^{-1} changed with dose and irradiation temperature. With increase in radiation dose (25°C) the intensity of the 1860-cm^{-1} band increased relative to "terminal unsaturation," –CF = CF_2. However, with an irradiation temperature of 250°C this band disappeared. With increase in the temperature (150, 250°C) a wide absorption band appeared in the 1600- to 1700-cm^{-1} region, which is related to formation of double bonds of the type CH = CH_2 or –CH = CH–. Based on the data obtained a mechanism is proposed for the destruction and structuring taking place during irradiation of a copolymer. (tr-auth)

28526 DISTRIBUTION OF GRAFTED POLYACRYLONITRILE IN SUPERFINE PERCHLOROVINYL FIBRES. Babkin, I. Yu.; Gordeev, Yu. M.; Kovalev, B. A. Vysokomol. Soedin., Ser. A; 16: No. 9, 2136-2140(Sep 1974). (In Russian)

For English translation see the journal Polym. Sci.

A study was made of the distribution of grafted polymer in a fiber, e.g., graft polymerization of acrylonitrile in superfine chlorinated polyvinyl chloride fibers by accelerated electrons at a dose rate of 0.1 to 0.8 Mrad/min. The theoretical distribution of the grafted polymer is characterized by a dimensionless parameter, α, depending on the diffusion coefficient, kinetic constant, rate of initiation, and fiber radius. With α values of 0.5 or less, when the graft polymerization took place in a kinetic field, there was uniform distribution of the grafted fiber polymer throughout the fiber mass. When α was 10 or higher, the grafting process was limited by diffusion of the monomer into the fiber and the grafting rate depended on the specific surface area of the fiber and the dose rate to the power 0.25. In this case the grafting took place basically in the presurface area of the fiber. The distribution of the grafted polyacrylonitrile in the fiber affected the microrelief of the surface, the kinetics of monomer sorption, and the properties of the modified fiber. (tr-auth)

28527 CALORIMETRIC INVESTIGATION INTO RADIATION POLYMERIZATION OF ACRYLONITRILE ADSORBED FROM GAS-PHASE ON SILICAGEL. Kritskaya, D. A.; Ponomarev, A. N. (AN SSSR, Moscow. Inst. Khimicheskoj Fiziki). Vysokomol. Soedin., Ser. A; 16: No. 9, 2020-2023(Sep 1974). (In Russian)

For English translation see the journal Polym. Sci.

The heat of γ initiation of polymerization of acrylonitrile adsorbed on silica gel was measured by calorimetry. The heat was not constant but depended markedly on the degree of covering of the substrate surface by the monomer. (tr-auth)

28528 PHOTOPOLYMERIZABLE MASSES AND THEIR HARDENING USING RADIATION. Bassemir, R. W.; Carlick, D. J.; Dennis, R.; Feig, G.; Nass, G.; Sprenger, G. (to Sun Chemical Corp., New York (USA)). German (FRG) Patent 1770825/A/. 19 Jun 1975. 14p. (In German)

The photo-polymerizable mass consists of a compound of the group of pre-polymers including the dimers and trimers of a polyethylene unsaturated ester of an aliphatic alcohol from the pentaerythrital and polypentaerythrital group. Bound to it is a photo-initiating compound of the acyloin derivates group, of aromatic, aliphatic or alicyclic hydrocarbons with at least one halogen atom on the aromatic nucleus, on the carbon drain or the alicyclic nucleus. Mixtures of substances of the individual groups can be used with those of the other group. The ester is e.g. an acryl, methacryl or itaconic acid ester and the halogen atom e.g. a chlorine, bromine or iodine atom. The photo-polymerizable compound is present in the mass to a weight percent of 15 to 98 and the initiating compound 2 to 85 wt.%. The mass is subjected to ultraviolet as well as to electron or γ radiation. (DE)

28529 ENDOR STUDIES OF METHYL RADICALS IN IR.RADIATED SINGLE CRYSTALS OF $CH_3COOLi{\cdot}2H_2O$. Toriyama, K.; Nunome, K.; Iwasaki, M. (Government Industrial Research Institute, Nagoya, Hirate, Kita Nagoya, Japan). J. Chem. Phys. 64: No. 5, 2020-2026 (1 Mar 1976).

The methyl radicals trapped in single crystals of $CH_3COOLi{\cdot}2H_2O$ irradiated at 77 °K have been studied by ENDOR. The proton hyperfine coupling tensor was determined to be (−21.30, −20.57, −21.61) G. The absolute sign of the coupling was determined in referring to the nuclear dipole-dipole interaction. The deviation from axial symmetry indicates that the methyl radical undergoes hindered oscillation about the second axis in the radical plane in addition to rapid reorientation about the C_3 axis. The superhyperfine coupling tensors were determined for all of the seven neighboring protons within 5 Å from the radical carbon atom. The nearest neighboring CH_3 and water protons gave the tensors (3.07, 0.24, 0.26) and (2.01, -1.16, -1.00) G, respectively. The dipolar terms of these neighboring protons and others lead to the conclusion that the methyl radical is trapped in practically the same position with the same orientations as those of the methyl group in the undamaged molecule. The precise analysis suggests that the recoil displacement of the CH_3 radical along the broken C–C bond is less than 0.3 Å. To facilitate analyses of the spectra, the second order effects on the ENDOR transition frequencies as well as the transition probabilities have been formulated in compact forms. (auth)

28530 RADIATION CHEMISTRY OF CARBOHYDRATES. V. γ-Radiolysis of Scyllo-Inositol in Deoxygenated and Oxygenated Aqueous Solution. Kirsch, A.; von Sonntag, C.; Schulte-Frohlinde, D. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr, Ger.). J. Chem. Soc. (London), Perkin Trans., II; No. 12, 1334-1338(1975).

Scyllo-Inositol was γ-irradiated in deoxygenated and oxygenated N_2O-saturated aqueous solutions. The products were identified and their G-values determined. In oxygen-free solutions at 0°C, the following products were found; (G values in parentheses): scyllo-myo-inosose (3.0), myo-inositol (2.1), deoxyinosose (1.1), and H_2O_2 (0.45). Except for H_2O_2, the G values depend on dose rate and temperature. A reaction scheme is given which accounts for these dependences. In oxygenated solution only scyllo-myo-inosose (6.15) and H_2O_2 (3.9) were observed. The G values did not vary much with temperature. (auth)

28531 DETECTION OF THE RADICAL H_2CO^+ BY ELECTRON SPIN RESONANCE. Mishra, S. P.; Symons, M. C. R. (Leicester Univ., Eng.). J. Chem. Soc. (London), Chem. Commun.; No. 22, 909-910(19 Nov 1975).

Exposure of solutions of formaldehyde in sulfuric acid to ^{60}Co γ-rays at 77 K gave a radical whose e.s.r. spectrum is in accord with the structure $H_2C\dot{O}^+$. (auth)

28532 EFFECT OF NO_3^- IONS IN THE GAMMA-RADIOLYSIS OF NEUTRAL AQUEOUS SOLUTIONS OF TETRANITROMETHANE AND FORMATE. Julien, R. (CNRS, Ivry-sur-Seine, France). Int. J. Radiat. Phys. Chem.; 7: No. 6, 741-748(1975). (In French).

By competition with the radical species which the presence of nitrite ions in aqueous solutions of tetranitromethane alone, or of tetranitromethane and formate, causes, it is possible to determine the value of the rate constants for the reactions of nitrite ions with these species: $k(NO_2^- + e_{aq}^-) = 3.45 \cdot 10^9 dm^3 mol^{-1} s^{-1}$; $k(NO_2^- + H) = 1 \cdot 10^9 dm^3 mol^{-1} s^{-1}$. The rate constant for the reaction of nitrite ions with the radical-ion O_2^- seems to be lower at $5 \cdot 10^6$ $dm^3 mol^{-1} s^{-1}$. (auth)

28533 NEGATIVE ION REACTIONS IN THE GAS PHASE. I. Ion-Clustering Reactions in Methyl and Ethyl Chloride. Luczynski, Z.; Wincel, H. (Inst. of Nuclear Research, Warsaw). Int. J. Radiat. Phys. Chem.; 7: No. 6, 705-711(1975).

The negative ion reactions in pure gaseous methyl chloride, ethyl chloride, $CH_3Cl–H_2$ mixtures and $C_2H_5Cl–H_2$ mixtures were studied in a high-pressure mass spectrometer in the pressure range from 0.3 to 5 torr (40 to 670 N m^{-2}) and at temperatures between 200 and 364°K. The Cl^- ion formed by the action of an electron produces $Cl^-(CH_3Cl)_n$, $Cl^-(C_2H_5Cl)_n$ from n = 1 to 3 as well as the mixed clusters containing H_2O and HCl ligands. The origin of HCl involved in the production of the ion clusters is discussed. (auth)

28534 NEGATIVE ION REACTIONS IN THE GAS PHASE. II. Effect of the Ionizing Electron Energy on Cl^- Solvation in Methyl and Ethyl Chloride. Luczynski, Z.; Wincel, H. (Inst. of Nuclear Research, Warsaw). Int. J. Radiat. Phys. Chem.; 7: No. 6, 713-718(1975).

The influence of the energy of ionizing electrons on the extent of the gas phase solvation of Cl^- formed from methyl and ethyl chlorides in the CH_3Cl, $CH_3Cl–H_2$, $CH_3Cl–He$, C_2H_5Cl and $C_2H_5Cl–H_2$ systems have been studied in a mass spectrometer over the pressure range 0.2 to 5 torr (27 to 670 N m^{-2}) and at temperatures from 335 to 365 K. The observations are discussed in terms of different excess translational energy of Cl^- produced by various dissociative channels. (auth)

28535 RADIATION-INDUCED DEGRADATION OF AZO DYES IN AQUEOUS SOLUTIONS. Suzuki, N.; Nagai, T.; Hotta, H.; Washino, M. (Japan Atomic Energy Research Inst., Takasaki). Int. J. Appl. Radiat. Isot.; 26: No. 12, 726-730(1975).

The aqueous solutions of Acid Red 265, Acid Red 37, Reactive Red 8, Reactive Red 3, Direct Red 79 and Direct Blue 78 were easily decolored by γ radiation. For the oxygen- and nitrogen-saturated solutions, the degree of decoloration, the change of pH, the total organic carbon content (TOC) reduction, the chemical oxygen demand (COD) reduction, and the amount of carbon dioxide formed were measured as functions of dose. After decoloration, the dye molecules are degraded to the lower molecular weight compounds mainly, such as organic acids, and finally to carbon dioxide. The degradation reaction is promoted markedly by oxygen. (auth)

28536 KINETICS OF THE ANNEALING OF RADIATION DAMAGE IN BARIUM CHLORATE MONOHYDRATE. Arnikar, H. J.; Patil, S. F.; Patil, B. T. (Univ. of Poona). Radiochem. Radioanal. Lett.; 24: No. 2, 67-79(30 Jan 1976).

Kinetics of the isothermal annealing of fragments formed in γ-irradiated barium chlorate monohydrate have been studied. Hypochlorite and chlorite are found to anneal by a combination of first and second order processes, whereas the formation of the stable product chloride follows complex kinetics. A mechanism consistent with the observed results is discussed. (auth)

28537 ELECTRON SPIN RESONANCE SPECTRA OF A NOVEL OXYL RADICAL OPF_4 AND RELATED SPECIES. Boate, A. R.; Morton, J. R.; Preston, K. F. (National Research Council of Canada, Ottawa). J. Phys. Chem.; 80: No. 4, 409-412(12 Feb 1976).

Intense ESR spectra observed in gamma-irradiated solid solutions of OPF_3 or NSF_3 in SF_6 are ascribed to the free radicals OPF_4 and NSF_4, respectively. The radicals are believed to have a distorted trigonal bipyramidal structure in which the equatorial plane contains two fluorine nuclei, an oxygen (or nitrogen) nucleus, and the central phosphorus (or sulfur) nucleus. The magnitudes of the observed hyperfine interactions indicate that the semioccupied orbital belongs to the representation B_1 in C/sub 2 upsilon/ symmetry and consists primarily of an oxygen (or nitrogen) 2p orbital whose nodal plane coincides with the equatorial plane of the molecule. Two derivatives of OPF_4 have been detected in gamma-irradiated SF_6 containing OPF_2Cl or $OPFCl_2$. These are believed to be OPF_3Cl and OPF_2Cl_2, respectively, in which the chlorine nuclei occupy equatorial positions and show no detectable hyperfine interactions with the unpaired electron. (auth)

28538 ELECTRON TRANSFER IN DINUCLEOSIDE PHOSPHATE ANIONS. Sevilla, M. D. (Oakland Univ., Rochester, MI); Failor, R.; Clark, C.; Holroyd, R. A.; Pettei, M. J. Phys. Chem.; 80: No. 4, 353-358(12 Feb 1976).

The electron transfer reaction within various dinucleoside phosphate radical anions has been investigated by ESR spectroscopy and pulse radiolysis. In the ESR work electrons are produced by photolysis of $K_4Fe(CN)_6$ in a 12 M LiCl glass at 77°K. Upon photobleaching the electrons react with the dinucleoside phosphate to form the anion radical. The anions of the four DNA nucleosides were also produced and their ESR spectra were appropriately weighted and summed by computer to simulate the spectra found for the dinucleoside phosphate anions. From the analysis the relative amounts of each of the nucleoside anions in the dinucleoside phosphate anion were determined. Evidence suggests the electron affinity of the pyrimidine bases are greater than the purine bases; however, the results are not sufficient to distinguish between the individual purine or pyrimidine. When dinucleoside phosphate anions containing thymidine are warmed, protonation occurs only on thymine to produce the well known "thymyl" spectrum. Pulse radiolysis experiments on individual nucleotides (TMP, dAMP), mixtures of these nucleotides and the dinucleoside phosphate, TdA, in aqueous solution at room temperature show that in the TdA anion electron transfer occurs from adenine to thymine, whereas no electron transfer is found for mixtures of individual nucleotides. Protonation is found to occur only on thymine in the TdA anion in agreement with the ESR results. (auth)

28539 KINETICS OF TWO SIMULTANEOUS SECOND-ORDER REACTIONS OCCURRING IN DIFFERENT ZONES. Dole, M.; Hsu, C. S.; Patel, V. M.; Patel, G. N. (Baylor Univ., Waco, TX). J. Phys. Chem.; 79: No. 23, 2473-2479(1975).

Equations have been derived for the case of free radicals recombining according to the second-order kinetics with or without diffusion control under the conditions that there are two simultaneous spatially separated recombination reactions but that only the overall free-radical concentration can be observed. The properties of these equations are discussed and methods for determining the three independent parameters in the first case and five in the second developed. The resulting equations have been applied to the interpretation of data obtained in studying the decay of allyl chain free radicals in irradiated extended chain crystalline polyethylene. (auth)

28540 STUDY OF LUMINESCENCE OF SOLIDS AND THE INFLUENCE OF SURFACE PROPERTIES FOR ^{60}Co-γ-IRRADIATED SILICA-GEL. Kirmaier, P. Berlin; Technische Univ. (1974). 65p. (In German). INIS.

Thesis.

Charge carriers are stabilized in traps in silica gel by γ-irradiation. By heating of gel irradiated at 77°K, radiothermoluminescence occurs at about 80°K. The intensity maximum is in the temperature region of 135-200°K depending on conditions and the whole luminescence is heated at about 400°K. The charge carriers producing the coloring and paramagnetic resonance recombine essentially above 400°K without luminescence. It can be seen from analysis of the glow curve that there is a distribution of traps having energy values between about 0.06-0.7 eV where the concentration of traps of smaller energy values greatly increases. The quantity of light emitted strongly increases with the radiation dose up to the saturation value reached at 0.9 Mrad. The attenuation of the isothermal thermoluminescence and of the optically stimulated luminescence takes place according to a hyperbolic time law as is to be expected from a model concept for a bimolecular reaction with strong retrapping. The state of the solid surface has a drastic influence on the thermoluminescence. The light quantity of the thermoluminescence increases by about a factor of 1,000 with increasing distance from hydroxyl groups on the surface with the raising of pretreatment temperatures from 488°K to 773°K. (DE)

28541 DECAY AND PROTONATION OF THE 5-CHLOROURACIL RADICAL ANION IN AQUEOUS SOLUTIONS. Wagner, B. O.; Schulte-Frohlinde, D. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr (F.R. Germany). Abt. fuer Strahlenchemie). Ber. Bunsenges. Phys. Chem.; 79: No. 7, 589-597(1975). (AED-CONF-73-430-021).

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, F.R. Germany (27 Sep 1973). 10 figs.; 3 tabs.; 42 refs. Pt. 9 of the series: Radiation chemistry of DNA model compounds.

The pulse radiolysis of 5-chlorouracil (ClUr) in airfree aqueous solution has been investigated. The rate constants for the reactions of the formation and the decay of the 5-chlorouracil radical anion have been measured at 21°C. The dissociation of $ClUr^-$ proceeded with an activation energy $E_{(a)} = (10.5 \pm 1)$ kcal/mol (44 kJ/mol) and an entropy of activation $\Delta S^{\ddagger}$ (25°C) = $-(1 \pm 5)$ eu. The value of the dissociation constant was determined by two independent methods which lead to the same value ($pK_3 = 5.0 \pm 0.2$ at 21°C). Computer

simulations using the obtained k values gave good agreement for the decay and the subsequent rise of the conductivity after pulse. G-values under ^{60}Co-γ-irradiations of 5-chlorouracil in aqueous de-aerated solutions containing tert.-butanol were: G(−ClUr) = 3.2 ± 0.3/100 eV, G(Ur) = 2.7 ± 0.2/100 eV and $G(Cl^-) = 2.7 \pm 0.1/100$ eV, at pH values of 6.5 (buffered) and 4.7 (unbuffered). Under pulse conditions the yield of chloride was $G(Cl^-) = 2.7 \pm 0.2/100$ eV in neutral and alkaline solutions, but was lower in acidic solutions (pH < 5) and at higher dose rates. (DE)

28542 ESR SPECTRA OF THE COMPLEXES OF THE O_2^--RADICAL ION WITH TITANIUM, ZIRCONIUM, NIOBIUM, AND TUNGSTEN IONS IN THE SOLID PHASE AT 77°K. Merkulov, A. A.; Sychev, O. F.; Berdnikov, V. M. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). J. Struct. Chem. (USSR) (Engl. Transl.); 16: No. 2, 169-174(1975).

Translated from Zh. Strukt. Khim.; 16: No. 2, 182-188(1975).

The principal values of the g-factor tensor and the hyperfine interaction tensor for various complexes of the O_2^--radical ion with titanium, zirconium, niobium, and tungsten ions have been obtained by numerical modeling of the anisotropic ESR spectra.

28543 RADIATION SULFOXIDATION OF n-PARAFFINS. III. Kinetics of the Decomposition of Persulfonic Acid: An Intermediate Reaction Product. Popov, A. I.; Mikhailov, G. G.; Zagorets, P. A.; Kosorotov, V. I.; Sobolev, I. A.; Dzhagatspanyan, R. V. Kinet. Catal. (USSR) (Engl. Transl.); 16: No. 2, 292-296(1975).

Translated from Kinet. Katel.; 16: No. 2, 346-351(1975).

The kinetics of the decomposition of persulfonic acid was studied at various temperatures, and a rate constant dependence on the composition of the reaction medium was found. Paraffinic hydrocarbon sulfoxidation occurs by chain mechanism with degenerate branching caused by the decomposition of an unstable intermediate, persulfonic acid. The optimum conditions for n-paraffin sulfoxidation were: 20°C, ratio of SO_2 to O_2 in the gas phase 2.3 : 1, and γ radiation dose rate 100 rad/sec. Rate constants for several elementary steps in the sulfoxidation of n-paraffins were calculated from the experimental data. The rate constants and stationary concentrations of radicals and reagents for the elementary reactions were tabulated. (DDA)

28544 MECHANISMS OF PROTECTION ACTION OF STYRENE UNITS IN γ-IRRADIATED COPOLYMERS OF ETHYLENE WITH STYRENE. Mal'tseva, A. P.; Golikov, V. P.; Leshchenko, S. S.; Karpov, V. L. (Physical-Chemical Inst., Moscow). Dokl. Chem. (Engl. Transl.); 223: No. 1-3, 396-398(Jul 1975).

Translated from Dokl. Akad. Nauk SSSR; 223: No. 1, 98-100(Jul 1975).

Gamma-irradiated ethylene−styrene copolymers were studied by ESR, uv and ir spectroscopy, mass spectroscopy, and other physicochemical methods in order to obtain as complete a picture as possible of the radiochemical processes taking place in the copolymer. From these data an evaluation was made of the protective action of the styrene units with respect to the ethylene chain. The results showed that the maximum protective effect in the radiolysis of a copolymer containing 5 mol % styrene is due to the formation of structures containing double bonds in the methylene sequences, conjugated with phenyl rings. (JSR)

28545 RADIATSIONNAYA OCHISTKA VODY. (Radiation Water Treatment). Dulin, P. I.; Shubin, V. N.; Brusentseva, S. A. Moscow; Izdatel'stvo Nauka (1973). 151p.

The inadequacy of present methods of purifying water made it necessary to develop new and more efficient methods. The monograph considers the possibility of using high-energy radiation in purifying various sources of water. Possible fields are analyzed for the use of radiation in purification processes. The book is intended for scientists and engineers dealing with industrial water supplies and natural polluted water sources, and also for specialists in the field of applied radiation chemistry. (tr-auth)

28546 STUDY OF ATOM AND RADICAL REACTIONS IN THE GAS PHASE BY THE ELECTRON SPIN RESONANCE METHOD. Prasil, Z. (Ustav pro Vyzkum, Prague). Radioisotopy; 16: No. 4, 485-528(1975). (In Czech).

A review is presented on the present status of the measurements of electron spin resonance (ESR) spectra of paramagnetic species in the gas phase. An elementary theory of the ESR spectrometry is presented together with its application to the gas-phase ESR spectra. Measurements of the gas-phase chemical kinetics of atoms and simple radicals with the ESR detection are described in detail. Along with the direct measurements of the ESR spectra in the gas phase also the techniques based on the freezing-out of radicals from the flow of reacting cases are described, as well as the techniques using the so-called spin-trapping method, in which the highly reactive primary radicals react to form more stable secondary free radicals. From the analysis of their ESR spectra the nature of the primary radical can usually be determined. (auth)

28547 KINETICS OF ELECTRON-ION RECOMBINATION IN IRRADIATED SOLID HYDROCARBONS. Yakovlev, B. S.; Novikov, G. F. (Inst. of Chemical Physics, Moscow). Int. J. Radiat. Phys. Chem.; 7: No. 6, 679-691(1975).

The kinetics of photocurrent, I_ϕ, induced by light in the wavelength range $\lambda \approx 1600$ nm in γ-irradiated 3-methylpentane (3MP), methylcyclohexane (MCH), and iso-octane were studied at 77°K. The decay curve of I_ϕ in iso-octane could be fitted with a second-order law with the rate constant, k_p, close to theoretical value, k_L, for diffusion-controlled recombination. This decay of I_ϕ was interpreted as recombination of free charges. The decay curves of I in 3 MP and MCH did not follow a simple first-order or second-order law; the formally computed value $k_p \gg k_L$. These decays of I_ϕ are assumed to involve the photocurrent component, I_g, related to geminate recombination. To describe the kinetics of I_g the time dependence of the current due to photoejection of trapped electrons has been discussed in the case of isolated pairs of charges trapped electrons and positive ions). The current I_g^N has been computed for the pairs comprising electrons photoejected N times before recombination. It has been shown that the decay curve I_g could be fitted by the function $\Sigma_{N=2}^{\infty} Y(N) I_g^N$, where $Y(N) \sim N^{-\frac{1}{2}}$. For large N the function Y(N) corresponds to the distribution function for ion-pair lifetimes $G(t) \sim t^{-\frac{1}{2}}$ accepted for liquid hydrocarbons for large t. The distribution function $N^{-\frac{1}{2}}$ was applied to describe the published data on time dependences of optical density, D, and quantum yield photobleaching of trapped electrons, and on decay of luminescence, L_r, in irradiated 3MP at 77°K. Good agreement with isothermal decays of D and L_r was obtained for the electron lifetime in a trap $\tau = 26$ min. (auth)

28548 PULSE RADIOLYSIS STUDY OF SOME PLATINUM(II) AND PLATINUM(IV) COMPLEX IONS IN AQUEOUS SOLUTIONS. The Formation and Characterization of Platinum(I) and Platinum (III) Transients. Storer, D. K.; Waltz, W. L.; Brodovitch, J. C.; Eager, R. L. (Univ. of Saskatchewan, Saskatoon). Int. J. Radiat. Phys. Chem.; 7: No. 6, 693-704(1975).

The technique of pulse radiolysis was used to study the reactions of the hydrated electron and H atom in aqueous media with platinum(II) amine complex ions; chloro(diethylenetriamine)platinum(II), chloro(1,1,7,7-tetraethyldiethylenetriamine)platinum(II) and bis-(ethylenediamine)platinum(II). The second-order rate constants for these reactions are near $1 \times 10^{10} dm^3 mol^{-1} s^{-1}$, and the products absorb in the region of 240 to 450 nm. A comparison of the spectral and kinetic properties of the transients indicates that the e_{aq}^- and H atom reaction products are different. The reactions of Cl_2^- with these complexes and with $PtCl_4^{--}$ occur rapidly (second-order rate constants greater than $1 \times 10^8 dm^3\ mol^{-1} s^{-1}$) to yield transients absorbing strongly in the region of 230 to 400 nm. Very similar products are formed through the reactions of trans-dichlorobis-(ethylenediamine)platinum(IV) ion with e_{aq}^-, H atom, methanol and isopropanol radicals; the associated rate constants range from $6.9 \times 10^8 dm^3 mol^{-1} s^{-1}$ for methanol radical to $6.6 \times 10^{10} dm^3 mol^{-1} s^{-1}$ for e_{aq}^-. Evidence is presented to show that these transients are platinum(III) species. Their possible structures and substitutional labilities are discussed. (auth)

28549 EFFECTS OF gamma⁻ AND X-IRRADIATION UPON ACTIVITY AND SELECTIVITY OF A SUPPORTED SILVER CATALYST IN THE OXIDATION OF ETHYLENE AND CARBON MONOXIDE. Mora Vallejo, R. J. Notre Dame, IN; Univ. of Notre Dame (1975). 118p. University Microfilms Order No. 76-2342.

Thesis (Ph. D.).

Effects of gamma and x-radiation on catalytic selectivity of supported silver catalysts for production of ethylene oxide via ethylene oxidation were compared by determination of radio-induced changes in conversion-yield profiles. Influence of photon energy on the kinetics of the irradiation process was studied by determination of conversion-yield profiles, using samples of catalyst exposed to x-rays of different mean photon energy and gamma-rays for different cumulative periods of time. The effect of gamma-radiation on catalytic activity of the same silver catalysts for carbon monoxide oxidation was analyzed by determination of the reaction kinetics before and after catalyst irradiation. (LK)

28550 PULSE RADIOLYTIC STUDY OF LIQUID PHASE FAST ELEMENTARY REACTIONS. Bertram, D.; Brede, O.; Helmstreit, W.; Mehnert, R. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Z. Chem.; 15: No. 4, 125-135(1975). (In German)

A review is given of reactions of excited molecules, free radicals, and ionic species possible to be investigated in liquid phase. (INIS)

28551 NUCLEAR IRRADIATION CHANGES WOOL. Schnautz, N. G.; Du Plessis, T. A. (Atomic Energy Board, Pelindaba,

Pretoria (South Africa). Chemistry Div.). Golden Fleece; 6-7, 9(Aug 1974). (In Afrikaans)

In collaboration with the South African Wool Board, an investigation was carried out at the National Nuclear Research Centre, Pelindaba on the possible improvement of certain nondesirable properties of wool by making use of radiation-induced grafting techniques. The process of which the surface properties of material can be modified to a large extent whilst retaining the original bulk properties is discussed in very general terms. (INIS)

28552 CHEMICAL CONVERSIONS OF CELLULOSE AND MONOCARBOXYCELLULOSE DURING GAMMA IRRADIATION. Kaputskii, F. N.; Kaputskii, V. E.; Mortina, T. P.; Mogulenko, A. V.; Gol'din, S. I.; Markevich, S. V. J. Appl. Chem. USSR (Engl. Transl.); 48: No. 9, 2111-2114(Sep 1975).

Translated from Zh. Prikl. Khim.; 48: No. 9, 2045-2050(Sep 1975).

The action of γ radiation on cellulose and monocarboxycellulose leads to formation of carboxyl and carbonyl (predominantly aldehyde) groups and to decrease of degree of polymerization. Increase of the radiation dose leads to breakdown of the supermolecular structure and to increased solubility of the products in water. (auth)

28553 ELECTRON SPIN RESONANCE STUDIES OF PEROXY RADICALS LABELED WITH ^{17}O IN POLYTETRAFLUOROETHYLENE. Che, M. (Institut de Recherches sur la Catalyse, CNRS, 69626, Villeurbanne and Laboratoire de Chimie des Solides, Université de Paris VI, 75230 Paris Cedex 05, France); Tench, A.J. J. Chem. Phys. 64: No. 6, 2370-2374 (15 Mar 1976).

The ESR spectrum of the radicals formed by the reaction of oxygen with γ-irradiated polytetrafluoroethylene (PTFE) has been obtained using oxygen isotopically labeled with ^{17}O. The presence of lines from two oxygen nuclei both labeled with ^{17}O confirms that peroxy radicals are formed. Two types of peroxy radicals are discussed; firstly, the peroxy chain radical ($-CF_2-CF(O_1O_2)-CF_2$) with $g_1=2.0220$, $g_{\parallel}=2.0060$, $a_1(1)=40\pm1$ G, $a_1(2)=89\pm1$ G at 300 K, and $g_{zz}=2.0380$, $g_{yy}=2.0065$, $g_{xx}=2.0026$, $a_{xx}(1)=46\pm1$ G, $a_{xx}(2)=107\pm1$ G at 77 K and secondly, the peroxy propagating radical ($-CF_2-CF_2(O_1O_2)$) with $g_{ao}=2.004$, $a_{ao}(1)=13\pm1$ G, $a_{ao}(2)=26.5\pm1$ G at 300 K and identical parameters to the peroxy chain radical at 77 K. The temperature dependence of the ESR spectra is analyzed in terms of the rotational freedom in the polymer. The peroxy chain radical undergoes rotation along the polymer chain axis and the peroxy propagating radical also has this rotation about the chain axis and in addition rotates about the C-O bond which is nearly perpendicular to the main chain axis. (auth)

28554 PRIMARY RADIATION PRODUCTS IN CYSTEINE HYDROCHLORIDE. Kou, W.W.H.; Box, H.C. (Department of Biophysics, Roswell Park Memorial Institute, Buffalo, New York 14263). J. Chem. Phys. 64: No. 7, 3060-3062 (1 Apr 1976).

ESR and ENDOR spectroscopy were used to identify three primary radicals in single crystals of cysteine hydrochloride x-irradiated at 4.2 °K. The reduction product is an anion formed by addition of an electron to the carboxyl group. One oxidation product results from the loss of the sulfhydryl hydrogen atom. Another oxidation product is an electron vacancy localized mainly on atomic chlorine. (auth)

28555 RELATIVE EFFECTIVENESS OF FAST NEUTRONS IN CREATING STABLE FREE RADICALS. Simmons, J. A. (Polytechnic of Central London); Bewley, D. K. Radiat. Res.; 65: No. 2, 197-201(Feb 1976).

The relative effectiveness of fast neutrons with respect to high-energy x rays in the creation of stable free radicals has been investigated. Alanine powder was used as the test material, and the concentrations of free radicals compared in an electron spin resonance spectrometer. It is believed that both the accuracy and the precision of our measurements show a considerable improvement over those reported previously, with a final uncertainty of less than 8 percent on the value of 0.65. Some relevant radiobiological data are examined in the light of this result. (auth)

28556 FREE-RADICAL FORMATION IN DEOXYTHYMIDINE-5'-MONOPHOSPHATE gamma-IRRADIATED IN FROZEN SOLUTION. A Computer-Assisted Analysis of Temperature-Dependent ESR SPECTRA. Gregoli, S.; Olast, M.; Bertinchamps, A. (Univ., Libre, Brussels). Radiat. Res.; 65: No. 2, 202-219(Feb 1976).

Neutral aqueous solutions of deoxythymidine-5'-monophosphate (dTMP) were irradiated at 77°K and then annealed step by step until no detectable ESR signal remained. The highly complex spectra so produced are greatly modified after each annealing step, suggesting the presence of a composite, transforming radical population. The radical of H-addition at C-6 of the thymine ring and the thymine radical anion are not the main products involved in this process. Two other radicals are formed, one having been identified as the radical of OH-addition at C-6 of thymine. Despite the large amount of experimental data accumulated, no positive identification can yet be made of its low-temperature precursor. Such radical species are formed at absolute concentrations comparable with those of radicals TH and T^-. This work was performed by computer-assisted analysis of the temperature-dependent ESR spectra. To facilitate the isolation of the single-component patterns, selective radical scavengers and suitable radiomimetics were used. Computer reconstruction of the experimental spectra from the component patterns revealed the relative and absolute kinetics of each radical species. (auth)

28557 FREE RADICALS FROM PURINE NUCLEOSIDES AFTER HYDROXYL RADICAL ATTACK. Schmidt, J.; Borg, D. C. (Brookhaven National Lab., Upton, NY). Radiat. Res.; 65: No. 2, 220-237(Feb 1976).

Free radicals from imidazole, caffeine, guanosine, deoxyguanosine, inosine, adenosine, deoxyadenosine, and adenine, as well as beta-D-ribose and beta-D-deoxyribose, were generated by reaction with OH from H_2O_2–Ti^{3+} at pH 1.5-2 and studied by ESR, using a computerized, Q-band, fast-flow system. Purine base radicals, plus sugar radicals in nucleosides, were always observed. Prior deuteration of C8 made possible the assignment of the observed 10–15 gauss doublet splitting to the C8 proton in guanine derivatives, and to the C2 proton in adenine derivatives and inosine. Hueckel calculations (and INDO in a few cases) on possible radical species suggest that hydroxyl addition on nitrogens in the purine ring or on C5 may be responsible for the species which are observed. In imidazole, the radical species is a hydroxyl adduct. An anomalous effect of deuteration of C8 on the spectrum obtained with caffeine is also reported. (auth)

28558 PULSE RADIOLYSIS STUDIES OF ELECTRON-TRANSFER REACTION IN MOLECULES OF BIOLOGICAL INTEREST. II. The Reduction of Cu(II)-PEPTIDE COMPLEXES. Faraggi, M.; Leopold, J. G. (Nuclear Research Centre–Negev, Beer Sheva, Israel). Radiat. Res.; 65: No. 2, 238-249(Feb 1976).

The reduction mechanism of two Cu(II)–peptide complexes, Cu(II)–$(gly)_3$ and Cu(II)–glutathione, was investigated using the pulse radiolysis method. The hydrated electron, used as a reducing agent, was found to react with the two complexes by a bimolecular process. In the Cu(II)–$(gly)_3$ complex the reaction of the e^-/sub aq/ is both with the Cu(II) ion and with the carbonyl group of the peptide bond to form a carbonyl "electron adduct" radical. This adduct transfers the electron in a first-order process to the Cu(II). In the Cu(II)–glutathione complex the decay of the electron was followed by an appearance of a transient absorption band centered at 410 nm. It was followed by a slower, small increase of absorption at the same wavelength (lambda/sub max/ equals 410). This band is assigned to the adduct of an electron with the disulfide bond of the glutathione (RSSR$^-$ radical ion). The radical ion is formed either by the direct reaction of e^-/sub aq/ with the disulfide bond and the transfer of an electron from the carbonyl adduct formed by the e^-/sub aq/ or entirely via the electron-transfer reaction from the adduct to the S-S bridge. The RSSR$^-$ decays via a first-order process at the same rate at which the Cu(II) is reduced. CO_2^- reduces the Cu(II) ion in the complexes via a bimolecular reaction. In the Cu(II)–glutathione complex a small part (10 percent) of the reduction of the Cu(II) proceeds via the disulfide bridge. The pathway of the reduction of the Cu(II) ion in peptide complexes by the hydrated electron may therefore be delineated: It proceeds from the bimolecular encounter step, in which the electron is attached to residues of the peptide (carbonyl and disulfide groups), followed by an intramolecular process to the Cu(I) ion. (auth)

28559 INTERACTION OF THE RADIOSENSITIZER PARA-NITROACETOPHENONE WITH RADIATION-INDUCED RADICALS ON NUCLEIC ACID COMPONENTS. Michaels, H. B.; Rasburn, E. J.; Hunt, J. W. (Univ. of Toronto). Radiat. Res.; 65: No. 2, 250-267(Feb 1976).

The techniques of optical and conductiometric pulse radiolysis were used to investigate the reactions of PNAP with the free radicals produced by •OH attack on uracil, dihydrouracil, ribose, and deoxyribose. Electron transfer from sugar radicals to PNAP occurs with moderate efficiency, the yields being 37 and 23 percent for deoxyribose and ribose, respectively. In the case of uracil and dihydrouracil, however, the radicals produced by reaction with •OH do not transfer an electron to PNAP; instead, an addition product with the sensitizer is probably formed. This transient product absorbs strongly in the near uv. A comparison with other electron-affinic sensitizers, namely, nifuroxime and menaquinone, indicates that radical addition reactions, and not electron-transfer reactions, are of major significance in the interaction of these sensitizers with the radicals produced by •OH attack on nucleic acid bases. Reports in the literature used as evidence in support of the electron-transfer mechanism are shown to be faulty, due to improper analysis of the experimental data. An attempt is made to

rationalize the various results reported for electron-affinic sensitizers. (auth)

28560 HYPERFILTRATION MEMBRANES PREPARED BY RADIOCHEMICAL GRAFTING OF STYRENE ONTO POLY(TETRAFLUOROETHYLENE). Influence of the Size and Shape of Emulsion Particles Used to Obtain the PTFE Film. Munari, S.; Vigo, F.; Nicchia, M.; Canepa, P. (Univ., Genoa). J. Appl. Polym. Sci.; 20: No. 1, 243-253(Jan 1976).

The hyperfiltration performances of membranes obtained from PTFE films sintered with different granulometric distribution emulsions were studied. It has been possible to show that: (1) large spherical particles lead to high flux, poor rejection membranes, and vice versa for small spherical particles; (2) the particle shape affects the membrane properties. "Stick" shaped particles lead to better rejection properties than the spherical and "fibrillar" ones. An attempt was also made to utilize a PTFE/PMMA porous support to make asymmetric membranes. (auth)

28561 RADIOLUMINESCENCE FROM SOLUTIONS OF FLUORESCENT COMPOUNDS IN SATURATED HYDROCARBONS. I. Luminescence Yields in Cyclohexane. Paligoric, D.; Klein, J. (Lab de Physique des Rayonnements et d'Electronique Nucleaire, Strasbourg). Int. J. Radiat. Phys. Chem.; 7: No. 6, 731-740(1975). (In French).

Results of a study of the evolution of radiation chemical luminescence yields G(RL) with concentration c of fluorescent solutes and charge scavengers in cyclohexane are presented. 1/G(RL) shows a linear dependence with $\sqrt{c}$; this fact is interpreted in terms of a radioluminescence mechanism based on neutralization processes occurring between anions and cations formed through charge scavenging by the solutes; capture constants are determined for different solutes PPD (bis(butyl-4 phenyl)-2,5 oxadiazole-1,3,4), PBD (butyl-4 phenyl-2 biphenyl-5 oxadiazole-1,3,4), $CHCl_3$, and C_2H_5Br). It is shown, furthermore, that a part of radioluminescence emission implies an energy transfer from excited cyclohexane molecules to the fluorescent solute, characterized by a rate constant of the order of $10^{12} mol^{-1} dm^3 s^{-1}$. (auth)

28562 STUDY OF QUENCHING EFFECTS AND EXCITING EFFECTS IN LIQUID SCINTILLANTS BASED ON DIOXANE. Bourdeaux-Pontier, M.; Dell'Amico, M.; Bisset, J. P.; Briand, C. (Univ., Marseille). Int. J. Appl. Radiat. Isot.; 26: No. 11, 688-693 (Nov 1975). (In French).

The scintillation yield and quenching effects of dioxane liquid scintillants containing a primary solute (PPO or PBD) have been studied. The quenching effect of dioxane radiolysis products, in particular of ethanol, was measured; quenchers that act because of their positive electron affinity show a less important effect on dioxane-PBD solutions. The reaction mechanism of naphthalene, that is generally present at high concentration in liquid scintillants based on dioxane, was studied. (auth)

28563 DECOMPOSITION PATHWAYS OF p-BROMOPHENOL ON GAMMA-IRRADIATION IN AQUEOUS SYSTEMS. Komiya, T. (Mie Univ., Tsu (Japan). Faculty of Agriculture); Kawakishi, S.; Namiki, M. Agric. Biol. Chem. (Tokyo); 38: No. 9, 1589-1595(Sep 1974).

In order to elucidate the radiolysis mechanism of p-bromophenol, quantitative determination of the radiolysis products was carried out by gas chromatography and polarography. G(−p·BP) and G(Br^-) were 3.86 and 2.58 at neutral pH, and 1.09 and 0.26 at pH 1.0, respectively. This, together with the radical scavenger effects indicated that hydrated electrons contribute principally to the degradation of p-bromophenol through debromination, followed by the formation of dimer and trimer products by phenylation of the resulting p-hydroxyphenyl radical. This chain-like reaction may cause the difference (G-value = 1.28) between G(−p·BP) and G(Br^-). The contribution of OH radicals to G(−p·BP) is known to be small as compared with other aromatic compounds, because of the poor yield of hydroxylated products such as hydroquinone, 4-bromocatechol and 4-bromoresorcinol. (auth)

28564 RADIATION INFLUENCE ON SOME PROPERTIES OF TRIGLYCINE SULPHATE. Kotlicka, E. (Politechnika Warszawska (Poland). Instytut Fizyki). Postepy Fiz.; 24: 167-176(1973). (In Polish).

A review is presented of investigations on the radiation influence on some properties of triglycine sulphate. There is given basic information about the structure and polarization mechanism in TGS. The influence of radiation on structure, thermal expansion coefficients, ferroelectric features including the magnitude and the shape of histeresis loop, coercion field, domain structure and dielectric constant were shown. Besides, the annealing effects of the crystals after irradiation are presented. (auth)

28565 EFFECT OF GAMMA IRRADIATION ON THE STRUCTURE OF POLYETHYLENE TEREPHTHALATE. Basinski, A.; Czerwinski, W.; Gonet, S. (Uniwersytet Mikolaja Kopernika, Torun (Poland). Instytut Chemii). Polimery; 18: No. 11, 586-588 (1973). (In Polish).

The effect of gamma-irradiation in the dose range of 0.25 to 15 Mrads on PET of different degree of crystallization has been studied. It has been found that the intensity of crosslinking and degradation processes depends on the degree of crystallization of PET. The occurrence of degradation at low doses of irradiation has been found, due, probably to the dispersion of crystallites at this dose level. (auth)

28566 FAST PROCESSES IN RADIATION CHEMISTRY AND BIOLOGY. Proceedings of the Fifth L. H. Gray Conference, Brighton, England, September 10–14, 1973. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975). vp.

Thirty-one papers were presented, in sections entitled: fast response techniques (including pulse radiolysis, conductivity methods and time-resolved E.S.R.); general chemistry (including reactions of hydroxyl radicals, "dry" and solvated electrons, fast oxidative reactions and dipole reorientation); biochemistry; the nucleic acids; enzymes and proteins; the cellular level. Separate abstracts were prepared for 25 papers. (UK)

For abstracts of individual papers see: 28567–28574, 29533–29543, 29556, 29581, 29582, 29598, 31055, and 31056.

28567 NEW METHOD FOR OBTAINING TIME RESOLVED OPTICAL SPECTRA OF TRANSIENTS PRODUCED BY A SINGLE PULSE OF ELECTRONS. Gordon, S.; Schmidt, K. H.; Martin, J. E. (Argonne National Lab., IL). pp 16-24 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

The essential features of the kinetic spectroscopic method and the kinetic spectrophotometric method are summarized. It is stated that the new method embodies some of the advantages of both. A diagram of the apparatus is shown. This is essentially a version of a conventional pulse radiolysis experimental arrangement with the modification that the usual monochromator is replaced by a spectrograph equipped with a horizontal and a vertical slit and the usual photomultiplier-amplifier detector is replaced by a streak camera (TRW) incorporating an image converter tube (ICT) and a TV camera interfaced to a 2000 channel Biomation transient recorder. The time resolved absorption spectrum (or emission spectrum) is displayed on the P-11 phosphor of the ICT. This image is focussed on the photoelements of the TV tube. The TV camera scans the image of the spectrum stored on these elements and the output of this scan is stored in the Biomation. This recorder is in turn interfaced to a Sigma 5 computer. Results are presented for several experiments, from which it is concluded that with the present equipment absorbances down to 0.02 can be measured, and a time resolution of 1 ns can be achieved. It is stated that with improved equipment it should be possible to extend the time resolution of the method to less than 50 picoseconds. (UK)

28568 APPLICATION OF CONDUCTIVITY TECHNIQUE IN PULSE RADIOLYSIS. Asmus, K. D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). pp 40-59 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

An AC and a DC set-up for pulse radiolysis conductivity measurements are discussed briefly. Several recent investigations using these methods on radiation chemical reduction and oxidation mechanisms are presented: (1) elimination of halide and nitrite ions from halogen and nitro substituted benzenes, pyrimidines and furanes following addition of hydroxyl radicals to a carbon atom carrying one of these substituents; (2) reduction of Co^{III} to Co^{II} in Co^{III} complexes by hydrated electrons leading to a step-wise breakdown of the complexes; (3) oxidation of organic disulfides, including some of biological interest, by hydroxyl radicals leading partially to the formation of relatively long lived positive ions, $RSSR^+$; (4) oxidation of thioethers to positive ions by hydroxyl radicals. (auth)

28569 PICOSECOND PULSE RADIOLYSIS WITH SINGLE FINE-STRUCTURE PULSES. Matheson, M. S.; Hart, E. J.; Jonah, C. D. (Argonne National Lab., IL). pp 85-94 of Fast

Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (Eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

Several examples are given of topics of general chemical as well as radiation chemical interest which are accessible to study through the use of pulse radiolysis apparatus with time resolution in the tens of picoseconds. The upgrading of the Argonne electron linear accelerator is described, the laser-photodiode technique, the irradiation cell and flow system, and the stroboscopic technique with Cherenkov analyzing light. Results of some experiments are presented and discussed to demonstrate advantages of working with a single fine structure pulse. Two advantages are stated to be (a) all hydrated electrons are the same age to better than +-25 picoseconds; and (b) observation of the decay of "spur" species such as the hydrated electron is not limited to the time window between fine structure pulses, but can be followed out to homogeneous distribution. (UK)

28570 EFFECT OF TEMPERATURE ON THE YIELDS AND REACTIONS OF SOLVATED AND "DRY" ELECTRONS IN VISCOUS AQUEOUS MEDIA. Buxton, G. V. (Univ. of Leeds, Eng.). pp 95-103 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

Pulse radiolysis of aqueous solutions containing 9.5 M LiCl in the temperature range 300 to 77°K produces solvated or trapped electrons, e_s^-, and Cl_2^- as observable species. $G\epsilon_{max}$ for Cl_2^- is virtually independent of temperature, and it is concluded that G (total ionization) is also insensitive to temperature change. In contrast, $G\epsilon_{max}$ for e_s^- decreases eight-fold between 230 and 130 K, indicating that fewer electrons become trapped as the temperature is lowered. G(total ionization) is estimated to be about 5. Added solutes which react efficiently with solvated electrons reduce $G\epsilon_{max}$ for e_s^- at the end of the pulse. This effect is larger the lower the temperature, and is due to the reaction of the precursor of e_s^-, designated the "dry" electron, with the solute competing with the trapping process. The relative reactivities of a number of solutes with the "dry" electron have been measured, and are found to be independent of temperature and different from the relative reactivities of the same solutes with e_s^-. The kinetics of the reactions of e_s^- fit the time dependent rate constant theory of R. M. Noyes, and reaction distances and diffusion parameters have been estimated. (auth)

28571 FAST OXIDATIVE REACTIONS FOLLOWING IRRADIATION IN AQUEOUS SOLUTIONS OF Cl^-, Br^-, AND CNS^-. Hunt, J. W.; Wolff, R. K.; Chenery, S. G. (Ontario Cancer Inst., Toronto). pp 109-122 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

The reactions of hydroxyl radicals, the oxidizing species produced by radiation, are well characterized for nanosecond times. Hamill suggested, however, that a normal competition scheme does not explain the observed results in concentrated solutions. Using the stroboscopic pulse radiolysis technique a study has been made of the initial reactions of scavengers such as Cl^-, Br^- and CNS^- in concentrations from 1 to 5 M. A fast component of the absorption signals has been observed with the time resolution as short as 18 ps. In all of the concentrated solutions studied, the normal absorption spectra and yields of Cl_2^-, Br_2^- and $(CNS)_2^-$ were found. A concentration of 1 M NaOH greatly reduced the yield of Cl_2^-, but not the yields of Br_2^- and $(CNS)_2^-$. The best model that has been found is to assume two steps in the reaction; that is the reaction of the short-lived species, H_2O^+, with the scavenger X^-, followed by a fast reaction between neighbouring molecules to produce the observed species, X_2^-. Recently, mixtures of Cl_2^- and scavengers such as dextrose and propanol were studied. The yield of Cl_2^- was reduced markedly. Since this observation cannot be accounted for by a normal competition scheme involving hydroxyl radicals, it is in support of the view that the initial positive ion, H_2O^+, is important in concentrated solutions. (auth)

28572 PULSE RADIOLYSIS STUDIES: REACTIONS OF HYDRATED ELECTRONS AND HYDROXYL RADICALS WITH CAMPHORQUINONE AND BENZIL. Vaish, S. P.; Singh, A. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). pp 123-132 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

Hydrated electrons react with camphorquinone to give its anion with λ_{max} at 305 nm and with benzil to give its anion with λ_{max} at 370 and 550 nm. The rate constant for the reaction of camphorquinone with hydrated electrons is equal to 2.8×10^{10} $M^{-1}s^{-1}$, and the pKa of the camphorquinone ketyl radical has been found to be 4.1. The hydroxyl radicals also react with the two diketones, giving transients with characteristic spectra. The λ_{max} for the transients derived from camphorquinone and benzil are at 520 and 390 nm, respectively. The formation of solute excited triplets is not observed on pulse radiolysis of aqueous solutions of these diketones. (auth)

28573 PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS OF DIHYDROPYRIMIDINES: THE ROLE OF THE CARBONIUM IONS. Hayson, H. R.; Phillips, J. M.; Richards, J. T.; Scholes, G.; Willson, R. L. (Univ. of Newcastle upon Tyne, Eng.). pp 241-246 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

Dihydropyrimidyl radicals ($PyH^\cdot$) produced in the pulse radiolysis of aqueous solutions of dihydropyrimidines by reaction with OH and H, are oxidized by Cu^{2+}, $Fe(CN)_6^{3-}$ and IO_4^- ions in an electron transfer process: $PyH^\cdot + Ox \rightarrow [PyH]^+ + Ox^-$. The carbonium ion undergoes solvolysis, finally producing parent pyrimidine and/or the corresponding hydrohydroxy pyrimidine. Kinetic studies show that the parent pyrimidine is formed in a first-order process, which is attributed to decay of an unstable intermediate resulting from the solvolysis reaction. (auth)

28574 POLAROGRAPHIC STUDIES OF SHORT-LIVED RADICALS IN AQUEOUS SOLUTIONS. Bansal, K. M.; Sellers, R. M. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). pp 259-263 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

The polarographic behavior of radicals produced by the pulse irradiation of N_2O saturated aqueous solutions of ethylene glycol, imidazole, uracil, and cytosine was investigated. In each of the cases studied the oxidation-reduction properties of the radicals at the end of the pulse and at later times (30 μs or more) were found to be significantly different at certain pH and electrode potentials. These changes are interpreted in terms of acid and/or base catalyzed rearrangements of the radicals. (auth)

28575 DEGRADATION OF MATERIALS AND OPTICAL COMPONENTS BY IONIZING RADIATIONS. Bourrieau, J.; Romero, M. (Official National d'Etudes et de Recherches Aerospatiales (ONERA), 31-Toulouse (France). Centre d'Etudes et de Recherches). pp 491-504 of Evaluation of Space Environment on Materials. International conference, Toulous, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974). (In French).

From international conference on evaluation of space environment on materials; Toulouse, France (17 Jun 1974).

Experimental procedures for lab simulation of space radiation effect on optical components have caused unavoidable extrapolations. Some studies are therefore necessary. As an example, description experiments carried out on two classes of materials Zerodur and a series of glasses, is given. Then, the problem of the standardization of tests, and difficulties resulting from the large variety of optical components and materials, are the subject of some comments. (FR)

28576 METHOD FOR IMPROVING THE MECHANICAL PROPERTIES OF LIGNO-CELLULOSIC MATERIALS. Gaussens, G. (to CEA, 75-Paris (France)). French Patent 2,241,384/A/. 30 May 1973. 14p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The ligno-cellulosic material is impregnated with at least one water-absorbent but not water-soluble polymer, comprising unsaturations, either lateral and/or terminal, and the whole is submitted to a cross-linking agent, said agent being preferably constituted by ionizing radiation. (FR)

28577 SOLVATION OF ELECTRONS IN ALCOHOL GLASSES FROM 10^{-6} TO 10^2 s AFTER PULSE RADIOLYSIS AT 77°K.

Miller, J. R.; Clifft, B. E.; Hines, J. J.; Runowski, R. F.; Johnson, K. W. (Argonne National Lab., IL). J. Phys. Chem.; 80: No. 5, 457-459(26 Feb 1976).

Spectral changes associated with solvation of electrons in glassy (77°K) methanol, ethanol, and 1- and 2-propanol have been studied from 10^{-6} to 10^{2} s after a short pulse of ionizing radiation. Continuous changes are observed over this wide range, except for the case of methanol, in which electron solvation appears to be nearly complete before 10^{-7} s. The data indicate a very wide range of relaxation times for electron solvation in frozen alcohols. Techniques for data collection over a wide time range are described in the supplementary material. (auth)

28578 SUBSTITUENT EFFECTS ON NITROAROMATIC RADICAL ANIONS IN AQUEOUS SOLUTION. Neta, P.; Meisel, D. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 80: No. 5, 519-524(26 Feb 1976).

The effect of substituents on the ESR parameters of nitroaromatic radical anions in aqueous solutions has been studied by observing the spectra of some 20 such radicals using the in situ radiolysis steady-state ESR technique. The results focus on the effect of substitution and disubstitution at positions ortho to the nitro group. Higher nitrogen splittings were found to result in lower hyperfine constants for both para and ortho protons (or methyl groups), while meta hydrogens are affected to a much smaller extent. An inverse linear correlation is in fact found between a/sub NO_2//sup N/ and a/sub para//sup H/. When a/sub NO_2//sup N/ increases to values greater than approximately 20 G the meta proton splittings become higher than those for the para and ortho protons. The effect of an ortho OH group is relatively small but the effect of its basic form (O^-) is comparable to that of a methyl group. A strong synergistic effect of the second substituent in ortho disubstituted nitroaromatics is observed. It is also found that the rate of electron-transfer reaction from $(CH_3)_2\dot{C}OH$ to the parent compounds can be correlated with the spin density on the ring of the resultant radical anion as indicated by the inverse correlation with a/sub NO_2//sup N/. (auth)

28579 KINETICS OF THE SORPTION OF THE PLUTONIUM HEXANITRATE COMPLEX ON IRRADIATED ANION-EXCHANGE RESINS. Kiseleva, E. D.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 8, 1248-1249(Aug 1975).

Translated from Zh. Fiz. Khim.; 49: No. 8, 2127-2128(Aug 1975).

A method is described for kinetic experiments together with the main procedures for the calculation of the internal diffusion coefficients of the plutonium hexanitrate complex and plutonium (IV) on anion-exchange resins having different chemical structures. (auth)

28580 RADIATION-CHEMICAL OXIDATION OF Ce^{3+} AND REDUCTION OF Ce^{4+} IN THE α AND γ RADIOLYSIS OF LiCl SOLUTIONS. Vladimirova, M. V.; Milovanova, A. S. High Energy Chem. (USSR) (Engl. Transl.); 9: No. 4, 309-311(1975).

Translated from Khim. Vys. Energ.; 9: No. 4, 357-360(1975).

The radiation-chemical oxidation of Ce^{3+} and reduction of Ce^{4+} in lithium chloride solutions ([LiCl] = 3-10 M, [HCl] = 0.1-0.2 M) has been investigated. It was found that Ce^{3+} is oxidized during α radiolysis and reduced during γ radiolysis. The oxidizing agent is the Cl_2^- radical, the yield of which is greater than the sum of the reducing agent yields in equivalents (H_2O_2, H) during α radiolysis and smaller during γ radiolysis. A calculation gave $k(Ce^{3+} + Cl_2^-) = (0.8\text{-}4.0) \cdot 10^4$ liter/mole·sec. (auth)

28581 ISOTOPE EFFECT IN γ-IRRADIATED ADSORBED AMMONIA. Lyapina, T. G.; Kotov, A. G. (Physicochemical Inst., Moscow). Dokl. Phys. Chem. (Engl. Transl.); 223: No. 1-3, 687-688(Jul 1975).

Translated from Dokl. Akad. Nauk SSR; 223: No. 1, 135-137 (Jul 1975).

The radiolysis of $^{14}NH_3$ and $^{15}NH_3$ adsorbed on KSK silica gel and on NaA zeolite was studied; and the values for chemical reaction yield, limiting radical concentration, rate constant for radical destruction, and average relative error in the measured radical concentration were tabulated. An isotope effect was observed for radiolysis of the silica gel-ammonia system, but not for the NaA zeolite-ammonia system. The influence of the proton-acidic centers of the silica gel system is proposed to be the cause of the isotope effect. (DDA)

28582 EFFECT OF INERT GASES ON THE RADIATION-CHEMICAL REACTION OF NITROGEN WITH METHANE. IV. Effect of Argon on Ammonia Formation. Trishkin, A. E.; Fomin, O. K. (Physical Chemistry Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 4, 318-319(1975).

Translated from Khim. Vys. Energ.; 9: No. 4, 365-366(1975).

The effect of argon on synthesis of ammonia by methane radiolysis was studied at 88 mm Hg, 28°C and a dose rate of 0.726×10^{16} eV/cm³sec. The dependence of the initial radiation chemical yield of ammonia on composition of the three-component system, N_2-CH_4-Ar was illustrated by a diagram prepared using a third-order polynomial. Argon appreciably sensitizes formation of ammonia possibly by promoting the formation of atomic hydrogen from methane. (DDA)

28583 APPLICATION OF HIGH-RESOLUTION SPECTROSCOPY TO THE STUDY OF THE VELOCITY DISTRIBUTION OF EXCITED HYDROGEN ATOMS FORMED BY THE DISSOCIATION OF HYDROCARBON MOLECULES DUE TO ELECTRON IMPACT. Polyakova, G. N.; Fizgeer, B. M.; Erko, V. F. (Physicotechnical Inst., Kiev). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 4, 320-322(1975).

Translated from Khim. Vys. Energ.; 9: No. 4, 367-369(1975).

A focused electron beam was passed through a flowing-gas target of C_2H_2, CH_2O, CH_4, C_2H_4, C_2H_6, or C_6H_6, and high resolution spectroscopy was used to study the velocity distribution of the hydrogen atoms formed over both rotational and translational energy levels. The temperature for the distributions was calculated and tabulated for each of the hydrocarbons. The maximum energy distribution was determined to be from 3-5 eV with the least energy for each hydrocarbon being observed for the hydrogen atoms in the state with principal quantum number, n = 3 (Hα line). (DDA)

28584 STUDY OF THE DISTRIBUTIONS OVER ELECTRONIC STATES OF THE HYDROGEN ATOMS PRODUCED BY THE DISSOCIATION OF HYDROCARBON MOLECULES BY ELECTRON IMPACT. Polyakova, G. N.; Fizgeer, B. M.; Ranyuk, A. I. (Kharkov State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 4, 323-324(1975).

Translated from Khim. Vys. Energ.; 9: No. 4, 369-370(1975).

The hydrogen atoms formed by the dissociation of C_2H_2, CH_4, C_2H_4, C_2H_6, and C_6H_6 by 300 eV electrons were studied to determine the energy distribution over the electronic states. Evidence indicates that the electronic states of the hydrogen atoms are populated according to the Boltzman equation. The effective temperatures of the hydrogen atom distributions over the electronic and translational states are 3300 and $(2.5\text{-}6) \times 10^4$°K. (DDA)

28585 RADIATION-CHEMICAL REACTIONS IN γ-IRRADIATED ALKALINE EARTH HYDROXIDES. Orlov, V. V.; Vasina, T. P.; Ermakov, V. I.; Zagorets, P. A. (Moscow Chemical Technology Inst.). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 4, 325-327(1975).

Translated from Khim. Vys. Energ.; 9: No. 4, 370-373(1975).

The effect of the surrounding matrix on the decomposition of hydroxyl ion and on the energy state of the stabilized radical was investigated. Polycrystalline powder samples of $Mg(OH)_2$, $Ca(OH)_2$, $Sr(OH)_2$ and $Ba(OH)_2$ were γ irradiated; and the ESR spectra indicated not only the presence of O^-, OH, and H radicals but also the formation of paramagnetic centers associated with natural defects in the crystal lattice. (DDA)

28586 COMPOSITION OF PRODUCTS FROM THE RADIOLYSIS OF 2-METHYLTHIOPHENE. Brodskii, E. S.; Lukashenko, I. M.; Voznesenskaya, S. V.; Nesterovskii, V. V.; Ermolaev, M. V.; Tveritneva, V. V. (Scientific-Research Inst. of Petroleum Refining, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 4, 328-330(1975).

Translated from Khim. Vys. Energ.; 9: No. 4, 373-375(1975).

The irradiation of 2-methylthiophene was carried out in glass vessels, using ^{60}Co γ rays at a dose rate of ~600 rad/sec to a total absorbed dose of 1.5×10^6 rad. Under these conditions the conversion of 2-methylthiophene to high-boiling products amounted to ~0.1%. The products were partially evaporated and then analyzed by mass spectrometry. The mass spectral data indicated a high probability of the occurrence of methylation, demethylation, and polymerization reactions resulting from γ radiolysis of 2-methylthiophene. (DDA)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 28432 and 29861.

28587 (ORNL-5111, pp 57-84) NUCLEAR CHEMISTRY. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Brief reports (about a page in length) are presented on topics such as the following: decay properties and x-ray identification of element $^{260}105$, isotopes of lawrencium, and element 106, measurement of the electron capture branch of the decay of ^{255}No;

transfer reactions that lead to the nuclei ^{245}Cf and ^{244}Cf; measurement of lifetimes of states in ^{165}Yb; lifetimes of high-spin rotational states in ^{232}Th; lifetime measurements and multiple Coulomb excitation in ^{162}Dy; fission in the 162-MeV ^{20}Ne bombardment of Ni; heavy-ion-induced fission and fusion of medium-mass nuclei; compound-nucleus reactions induced by ^{40}Ar with ^{160}Dy, ^{164}Dy, and ^{174}Yb; multinucleon-transfer reactions with ^{40}Ar beams; measurement of the neutron fission cross section for ^{245}Cm by using time-of-flight techniques; the neutron capture cross section of ^{33}S to 850 keV; the neutron capture cross section of ^{59}Ni to 13 keV; measurement on the 22-eV doublet in the ^{232}Th(n,gamma)^{233}Th reaction; E0/E2 transition strengths and interpretations of 0^+, 2^+ states in ^{178}Hf; low-intensity beta transition in the decay of ^{99}Tc; ^{136}Nd decay and the ^{136}Pr ground-state spin; decay of ^{195}Pb. 15 figures, 10 tables. (RWR)

28588 RADIOACTIVE LABELING OF PROTEINS WITH AN IODINATED AMIDINATION REAGENT. Wood, F. T.; Wu, M. M.; Gerhart, J. C. (Univ. of Pacific, San Francisco). Anal. Biochem.; 69: No. 2, 339-349(Dec 1975).

An iodinated derivative of the imidoester methyl p-hydroxybenzimidate HCl (MPHBIM) has been synthesized for the selective labeling of proteins to high specific activity with radioactive iodine. In the first step, MPHBIM is reacted with radioactive iodide in the presence of chloramine T, and the iodinated derivative is precipitated from acidified solution to achieve partial purification. In the second step, the iodinated imidoester is redissolved at slightly alkaline pH and reacted with protein amino groups, to which it couples by amidine linkage. The coupling reaction proceeds in the presence of sulfhydryl reagents used to protect proteins. The main advantage of this two-step labeling procedure is that it avoids direct contact of the protein with potentially deleterious materials such as chloramine T or contaminants of the radioactive iodide. (auth)

28589 PREPARATION OF ^{125}IODINE-LABELLED INSULIN AND GLUCAGON. Ziegler, M.; Klatt, D. (Zentralinstitut fuer Diabetes, Karlsburg (German Democratic Republic)). Radiol. Diagn.; 16: No. 1, 23-28(1975). (In German)

In the present paper the iodine labelling of insulin and glucagon with a modified chloramine T method is described. The substitution of metabisulphite by human serum albumin towards the end of iodization yielded a better quality of ^{125}I-insulin and ^{125}I-glucagon for the RIA. Immunoreactivity of ^{125}I-insulin was significantly improved thereby from 84.29 ± 1.89% to 93.55 ± 0.77% ($\bar{x}$ ± SEM; n = 12; $p < 0.01$). Simultaneously, its unspecific coprecipitation with alcohol in absence of antiserum was decreased from 7.89 ± 0.62% to 4.99 ± 0.33% ($p < 0.01$). Reactivity of ^{125}I-glucagon in antiglucagon serum excess was increased by the addition of HSA instead of $Na_2S_2O_5$ from 72.96 ± 2.39% to 90.58 ± 1.08% ($p < 0.01$) whereas its unspecific bound remained uninfluenced. A damage of ^{125}I-insulin by sulphitolysis of disulphide bounds in the insulin molecule by metabisulphite in presence of atmospheric oxygen is discussed. (GC)

Hot-Atom Chemistry

Refer also to abstract 31022.

28590 INTERACTION OF TRIPLET SILICON DIFLUORIDE WITH PARAMAGNETIC MOLECULES. Zeck, O. F.; Su, Y. Y.; Tang, Y. N. (Texas A and M Univ., College Station). J. Chem. Soc. (London), Chem. Commun.; 155-157(1975).

Recoil ^{31}Si atom reactions with PF_3 resulted in the formation of both singlet and triplet $^{31}SiF_2$ in the ratio 1.0 : 3.5 where the triplet species was found to interact with paramagnetic molecules forming $^{31}SiF_2$-donor complexes towards buta-1,3-diene. (auth)

28591 CHEMICAL STATE OF ^{83}Br FORMED IN THE β DECAY OF ^{83}Se IN POTASSIUM SELENATE. Tenorio, D. (Instituto Nacional de Energia Nuclear, Mexico City); Bulbulian, S.; Adloff, J. P. Radiochem. Radioanal. Lett.; 24: No. 2, 61-66(30 Jan 1976).

The distribution of the chemical forms of ^{83}Br produced by β decay of ^{83}Se in potassium selenate has been investigated under various conditions. In crystals at room temperature the yields are: Br^- 48%, BrO_3^- 28%, BrO_4^- 24%. (auth)

28592 COMPARISON OF THE BEHAVIOR OF PHOTOCHEMICALLY PRODUCED SPECIES IN $Co(ACAC)_3$ BENZENE SOLUTIONS WITH THE BEHAVIOR OF ^{60}Co-RECOIL SPECIES IN THE SIMILAR SYSTEMS. Nichi, Y.; Tominaga, T. (Univ., Tokyo). Radiochem. Radioanal. Lett.; 24: No. 4, 249-254(20 Feb 1976).

The effects of additives on the behavior of the $Co(acac)_2$ produced photochemically in $Co(acac)_3$ benzene solutions were compared with those previously observed for the ^{60}Co recoil species in $Co(acac)_3$ benzene solutions. The reformation of $Co(acac)_3$ from $Co(acac)_2$ was found to be enhanced in the presence of less stable metal acetylacetonates, indicating a striking similarity to their effect on the reactions of the ^{60}Co recoil species. (auth)

28593 FURTHER INVESTIGATIONS ON NEUTRON IRRADIATED CHROMIUM TRISACETYLACETONATE. Mathieu, J. P.; Vargas, J. I. (CENG, Grenoble, France). Radiochem. Radioanal. Lett.; 24: No. 5-6, 323-329(4 Mar 1976).

Four ^{51}Cr-labelled recoil species have been detected in low-temperature neutron-irradiated chromium trisacetylacetonate. These are parent molecule (~2.5%), two intermediate fractions tentatively ascribed to $[Cr^{+III}(acac)_2]$ (~3%) and $[Cr^{+II}(acac)]$ (~2.1%), and ionic $^{51}Cr^{3+}$ (~92%). A mechanical model is proposed for the observed initial retention. (auth)

28594 COMPARATIVE MOESSBAUER STUDY OF THE POST-EFFECTS OF ELECTRON CAPTURE AND β DECAY IN COBALT-57 AND TELLURIUM-129 ATOMS SORBED ON CATIONITES. Ablesimov, N. E.; Bondarevskii, S. I.; Kirin, I. S. (Inst. of Nuclear Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 4, 315-317(1975).

Translated from Khim. Vys. Energ.; 9: No. 4, 363-365(1975).

Moessbauer emission spectra were obtained for ^{57}Co and ^{129}Te sorbed on the following cationites: KU-2 containing 2, 8, and 20% divinylbenzene, zirconium phosphate, and titanium hydroxide. Analysis of the spectra indicates that post effects of electron capture and β decay differ in the system studied. The qualitative difference in post effects of the different nuclear transformations is proposed to be a result of the different mechanisms for the activation of "daughter" ions, which leads, in the electron capture case, to extensive ionization of the "hot" atoms. (DDA)

Properties of Radioactive Materials

Refer also to abstracts 28433, 28438, 28487, 30043, 30093, 30339, and 30372.

28595 (COO-2361-3) LABELING PHARMACEUTICALS WITH RADIOACTIVE ISOTOPES. Annual Progress Report, December 1, 1975–November 30, 1976. Blau, M.; Bender, M.A. (Roswell Park Memorial Inst., Buffalo, N.Y. (USA). Dept. of Nuclear Medicine). 1976. Contract AT(11-1)-2361. 8p. Dep. NTIS $3.50.

Progress is reported in studies on the synthesis of gamma-emitting analogs of aliphatic amino acids which may be clinically useful for the localization of pancreas. The gamma radionuclides to be incorporated include ^{131}I, ^{123}I, and ^{77}Br. Preparation of beta-chloro-alpha-aminobutyric acid which on interchange with ^{131}I would yield I-for-methyl analog of valine is reported. This interchange is being currently studied. The bromo derivative was also prepared and should be a more reactive substrate for halogen interchange reactions or direct isotope exchange with ^{77}Br. Concurrently, the synthesis of the I-for-methyl analog of leucine is underway. In this connection, two intermediates were prepared, namely, allyl glycine and alpha-amino-gamma-valeralactone · HCl. (auth)

28596 (ORNL-5111, pp 30-44) CHEMISTRY OF TRANSURANIUM ELEMENTS. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

The half-wave amalgamation potential of No (element 102) was determined. Studies on the preparation and properties of Cf are reported; previously reported results on Es were confirmed. The heat of solution of Bk was measured. Spectroscopic and x-ray diffraction studies of Es-253 bromides are reported. Salicylate complexes with Sm(III), Am(III), Th(IV), and $U(IV)O_2$ were prepared; crystal data are given. Results of studies on the effect of secondary bonds on the strength of O double bond Np double bond O bonds are reported. The M series x rays of Np were measured. Anomalous spin–orbit splitting of the 4f level in the actinide series is reported. Progress is reported in studies on the Cf oxide system for oxygen pressures up to 760 mm and temperatures between 25 and 1000°C, as well as structural parameters of transplutonium oxysulfates and oxysulfides and actinide and lanthanide hydroxides. The electron paramagnetic resonance spectrum of $^{253}Es^{2+}$ was observed in the cubic monocrystal hosts BaF_2 and $SrCl_2$. (JGB)

28597 HALF-LIFE VARIATION IN THE COPPER METAL/OXIDE AND PHTHALOCYANINE RECOIL SYSTEMS. Johnson, J. A.; Dema, I.; Harbottle, G. (Brookhaven National Lab., Upton, N. Y. (USA). Dept. of Chemistry). Radiochim. Acta; 21: No. 3/4, 196-199(1974).

2 tabs.; 13 refs.

A comparison was made, by a differential counting technique, of the radioactive decay rates of ^{64}Cu atoms in recoil and in lattice sites in β copper phthalocyanine which had been irradiated

with neutrons. No chemical effect on the rate of decay was observed. A few analogous experiments with α copper phthaloxyanine likewise show no chemical effect on decay, though with some-what larger limits of error. There is also no measurable difference in the decay rate of ^{64}Cu in the metal and oxide. (DE)

28598 TRIS(eta^5-CYCLOPENTADIENYL)ALKYL AND -ALKENYL COMPOUNDS OF THORIUM(IV). Marks, T. J.; Wachter, W. A. (Northwestern Univ., Evanston, IL). J. Am. Chem. Soc.; 98: No. 3, 703-710(4 Feb 1976).

The syntheses of a number of (eta^5-C_5H_5)$_3$ThR organometallics from (eta^5-C_5H_5)$_3$ThCl and the corresponding RLi or RMgX reagents are reported. The new compounds have been characterized by chemical means, and by infrared, laser Raman, and proton NMR spectroscopy. The properties of these thorium organometallics are compared to those of the analogous (C_5H_5)$_3$UR compounds. With both elements the (C_5H_5)$_3$M(allyl) species is a fluxional eta^1-allyl; the barriers to sigmatropic rearrangement are comparable. The Th–C bond reacts more readily with protonic solvents. The (C_5H_5)$_3$ThR compounds are more thermally stable in solution. The thermolysis pathway is similar to uranium, with intramolecular extrusion of R–H taking place (H derived from a cyclopentadienyl ring) rather than olefin elimination. For thorium, the other product of thermolysis is (eta^5-C_5H_5)$_2$Th(eta^1:eta^5-C_5H_4)$_2$Th(eta^5-C_5H_5)$_2$, which appears to arise via an intermediate eta^1-C_5H_4 carbene complex-ylide. Coordinative saturation and 5f electron configuration play an important role in directing the course of certain types of reactions of organoactinides. (auth)

28599 A STUDY OF THE INFLUENCE OF THE CHEMICAL STATE OF U ON ENERGY OF ITS X-RAY EMISSION L-SPECTRA. Makarov, L. L.; Suglobova, I. G.; Karazya, R. I.; Zaitsev, Yu. M.; Batrakov, Yu. F.; Chibisov, N. P. Vestn. Leningr. Univ., Fiz., Khim.; No. 3, 87-96(Aug 1975). (In Russian).

Chemical shifts (δ) of the X-ray L (α_1, β_2, β_5, β_1 and γ_1) emission lines were measured in compounds UBr_3, U^0_{met}, UO_3, U_3O_8, UO_2F_2, $UO_2(NO_3)_2$, UF_4, and UF_5 with respect to UO_2. The data were interpreted and compared with the theoretically expected (relativistic and nonrelativistic) chemicals shifts for the isolated atom $_{92}$U and its ions. It is pointed out that the diagram δ-type of X-line for the compounds of U(VI) with respect to U^0_{met} creates a particular "facsimile" predicted by the theory for the removal of 5f-electrons from $_{92}$U. This may be considered as an evidence of involving 5f-electrons in chemical bonding at least in the compounds of U(VI). (auth)

28600 ION-MOLECULE REACTIONS IN URANIUM HEXAFLUORIDE. McAskill, N. A. (Australian Atomic Energy Commission Research Establishment, Sutherland). Aust. J. Chem.; 28: No. 9, 1879-1891(Sep 1975).

The ion-molecule reactions of UF_6 in the gas phase were studied in a mass spectrometer fitted with a medium-pressure ion source. The main reactions were the collision-stabilized formation of $U_2F_{11}^+$ from UF_5^+, $U_2F_{10}^+$ from UF_4^+ and $U_3F_{16}^+$ from $U_3F_{15}^+$. Rate coefficients for the reactions of UF_5^+ and UF_4^+ with UF_6 and the distribution of their products were found to depend upon the ion kinetic energy. (auth)

28601 INFRARED ABSORPTION AND RAMAN SCATTERING SPECTROSCOPIC STUDIES OF CONDENSED IONS. I. The Complex $K_3(UO_2)_2F_9$. Dao, N. Q.; Knidiri, M. (Ecole Centrale des Arts et Manufactures, Chatnay–Malabry, France). Spectrochim. Acta, Part A; 31: No. 12, 1829-1838(Dec 1975). (In French).

Infrared and Raman spectra of the complex $K_3(UO_2)_2F_9$ were recorded in the region 4000 to 80 cm^{-1}. Factor group analysis was used to classify the internal vibrations of the binuclear ion $(UO_2)_2F_9^{3-}$. Infrared and Raman spectra were assigned and splitting of the internal modes of the $(UO_2)_2F_9^{3-}$ anion interpreted. (auth)

28602 PRODUCTION OF ^{73}Se BY THE (p,3n) REACTION ON As_2O_3 AND ITS APPLICATION TO THE CHEMICAL EFFECTS OF β^+ AND ELECTRONIC CAPTURE DECAYS IN SELENIUM COMPOUNDS. Duplatre, G.; Herment, J. (Laboratoire de Chimie Physique Nucleaire, Grenoble, France). Radiochem. Radioanal. Lett.; 24: No. 2, 137-142(30 Jan 1976).

An As/Se chemical separation has been used in the synthesis of ^{73}Se labelled K_2SeO_4 and SeO_2. Preliminary results on the β^+ and E. C. decay effects gave 100% As^V from Se^{VI} and a nearly 1/3 to 2/3 distribution for As^{III} and As^V in SeO_2. (auth)

28603 PREPARATION OF 6-(2'-HYDROXYBENZYLAMINO) PURINE-^{3}H. Hanus, J.; Benes, J. (Isotope Lab., Prague). Radiochem. Radioanal. Lett.; 24: No. 2, 117-122(30 Jan 1976).

6-(2'-Hydroxybenzylamino)purine(I) was prepared and optimum conditions for its purification were found. A method of preparation of (I) labelled with tritium in the benzylamine chain was employed and yields better than 20 Ci/mmol were obtained. The chemical and radiochemical purity was very good. (auth)

28604 THERMAL AND INFRARED STUDIES ON DIAQUODIHYDROXOSELENITO DIURANYLATE [$(UO_2)_2SeO_3(OH)_2 \cdot 2H_2O$]. Khandelwal, B. L.; Verma, V. P. (Indian Inst. of Tech., New Delhi). Indian J. Chem.; 13: No. 9, 967-968(Sep 1975).

Thermal and IR data of diaquodihydroxoselenito diuranylate, $(UO_2)_2SeO_3(OH)_2(H_2O)_2$ reveal the coordination of water and hydroxy groups to the uranyl ions. Large splitting and lowering of the antisymmetric vibrational modes of SeO_3^{2-} suggest the bidentate linkage of the selenite ion through two of its oxygens to the uranyl ion. Negligible solubility in common solvents and high thermal stability indicate its polymeric structure. (auth)

28605 PREPARATION OF THE SEMISYNTHETIC TRITIATED INSULIN WITH A SPECIFIC RADIOACTIVITY OF UP TO 20 CURIES PER MILLIMOLE. Halban, P. A.; Offord, R. E. (Oxford Univ.). Biochem. J.; 151: No. 2, 219-225(Nov 1975).

The semisynthesis is described of [^{3}H] insulin of high specific radioactivity and indistinguishable from native insulin in its hypoglycaemic activity towards mice. The maximum specific radioactivity so far obtained was 20 Ci/mmol. At this value, the recommended scale of preparation is between 1 mCi (30 μg) and 10 mCi (300 μg). Reaction volumes are then of the order of 10 μl. Special problems arose when the techniques of peptide synthesis were applied to the production of such small quantities of material. These problems are described and the means of overcoming them discussed. (auth)

28606 NEW URANIUM AND THORIUM CROWN ETHER COMPLEXES. Costes, R. M.; Folcher, G.; Plurien, P.; Rigny, P. (CEN de Saclay, Gif-sur-Yvette, France). Inorg. Nucl. Chem. Lett.; 12: No. 1, 13-21(1976).

The complexing ability of macrocyclic polyethers with cations of several classes of elements are now well known, not only with alkali or alkaline earth salts but also with Co^{II}, Ni^{II}, Cu^{II} and some other monovalent or divalent metals, and even with rare earth salts. Costes et al. [Inorg. Nucl. Chem. Letters 11, 469(1975)] recently reported the synthesis and some spectroscopic studies of a uranyl complex with the ligand 18.crown-6 (Systematic name: 1,4,7,10,13,16 hexaoxacyclooctadecane), the first complex of this type with an actinide cation. A report is now presented on analogous studies with uranium (IV) and thorium (IV) salts and also other uranyl complexes. In all the complexes the metal cation is presumably inserted in the macrocyclic ligand. This view is supported by the spectroscopic results which are presented. (auth)

28607 PREPARATION AND SPECTRAL PROPERTIES OF ACTINIDE (IV)–HEXAIODO COMPLEXES. Brown, D.; Lidster, P.; Whittaker, B.; Edelstein, N. (Univ. of California, Berkeley). Inorg. Chem.; 15: No. 3, 511-514(Mar 1976).

Hexaiodo complexes of the type R_2M/sup IV/I_6 (R equals NEt_4, NMe_3Ph; M/sup IV/ equals Th, Pa, U) have been prepared by reactions in oxygen-free, anhydrous methyl cyanide. Ir and Raman data are reported together with electronic spectral results for the protactinium(IV) and uranium(IV) complexes. Ligand field and spin–orbit coupling constants derived for the hexaiodoprotactinates(IV) are discussed in relationship to values obtained earlier for other hexahalogenoprotactinates(IV), $(NEt_4)_2PaX_6$ (X equals F, Cl, Br). (auth)

28608 SYNTHESIS AND VIBRATIONAL AND MAGNETIC RESONANCE SPECTROSCOPIC STUDIES OF COVALENT ORGANOMETALLIC TETRAHYDROBORATES AND ORGANOMETALLIC URANIUM(IV) COMPLEXES. Kolb, J. R. Evanston, IL; Northwestern Univ. (1975). 203p. University Microfilms Order No. 75-29,682.

Thesis (Ph. D.).

Vibrational spectroscopy was used for unambiguous distinction of the bonding mode in covalent organometallic tetrahydroborates. Tetrahydroborate complexes of Ti, Zr, and Hf were studied as were the complexes (eta^5-C_5H_5)$_3$ U(BH_4) and (eta^5-C_5H_5)$_3$ Th(BH_4). Bidentate and tridentate hydrogen bridged metal-BH_4 interactions are readily distinguishable and are found to predominate in these complexes. (DLC)

28609 STUDIES ON THORIUM PHOSPHATE ION EXCHANGER. III. Paper Chromatographic Behavior and Separations of Metal Ions on Thorium Phosphate Papers. De, A. K.; Chowdhury, K. (Dept. of Chemistry, Santiniketan, India). Sep. Sci.; 10: No. 5, 639-648(1975).

Thorium phosphate papers have been prepared by treatment with thorium nitrate and phosphoric acid solutions. Several metal ions have been chromatographed on thorium phosphate paper. The effect of pH on R/sub F/ values has been investigated. Some useful analytical separations of metal ions have been achieved by using only dilute mineral acid and a mixed solvent system. (auth)

28610 METHOD FOR THE PREPARATION OF ^{192}Ir TRACER SOLUTIONS. Baghai, A.; Bowen, H. J. M. (Univ. of Reading

Whiteknights, Reading, Eng.). Radiochem. Radioanal. Lett.; 24: No. 5-6, 347-352(4 Mar 1976).

A method is described for the complete dissolution of radioactive iridium metal which yields the element 100% as a chlorocomplex of iridium (IV). Other methods fail to give this result. Dissolution was carried out in a sealed tube containing hydrochloric acid and sodium chlorate between 150° and 340°C. (auth)

28611 URANIUM (IV) CARBOXYLATES-III. Malate Compounds of Uranium (IV). Satpathy, K. C.; Biswal, S. C. (Sambalpur Univ. Post-Graduate Dept. of Chemistry, Burla (India)). J. Indian Chem. Soc.; 52: No. 4, 327-329(Apr 1975).

Uranium (IV) dimalate, $U(C_4H_4O_5)_2$, H_2O has been prepared by photolytic method. The compound is green crystalline solid, sparingly soluble in water, insoluble in organic solvents but goes into solution when treated with alkali malate solution forming the complex ions, UM_2^{-2} and U_2M_{-2}. Soluble complex compounds of the types, $R_2(UM_3)$, nH_2O and $R_2[U_2M_5]$, nH_2O (where R = Na^+, K^+ and NH_4^+ and M = malate ion) are prepared by treating uranium (IV) malate in the aqueous solution of different concentrations of alkali malates. The IR spectra of the compounds are recovered and basing on the IR data the structures have been suggested. (auth)

28612 INVESTIGATION OF MECHANISM OF CHEMICAL REACTIONS IN INDUSTRIES. Akerman, K. pp 12-30 of Radiotracer Method in Practical Work. Bratislava; ALFA (Dec 1972). (In Slovak)

Pages 7-367-translation of "Techniczne zastosowanie metody atomow znaczonych," Warsaw, 1970.

Radiotracer methods are described and illustrated by examples of their use in the investigation of the mechanisms of chemical reactions important for industrial applications. (INIS)

28613 KINETICS OF TECHNOLOGICAL PROCESSES. Akerman, K. pp 31-61 of Radiotracer Method in Practical Work. Bratislava; ALFA (Dec 1972). (In Slovak)

Pages 7-367-translation of "Techniczne zastosowanie metody atomow znaczonych," Warsaw, 1970.

Radiotracer methods are described as used in the investigation of the kinetics of chemical reactions important for technological applications, and illustrated by examples. (BS)

28614 CHROMATOGRAPHY OF $Na^{125}I$ ON SEPHADEX GELS. Wilson, N.; Greenhouse, V. Y. (Univ. of British Columbia, Vancouver). J. Chromatogr.; 118: No. 1, 75-82(3 Mar 1976).

Elution volumes of NaI and $Na^{125}I$ appear to differ significantly when chromatographed on Sephadex G-15 or G-10. Using distilled water as the eluent, radioiodide was eluted in the void volume of the column while NaI was found eluted after NaCl. However, in most other eluent systems studied, radioiodide was retarded in comparison with NaI. This retardation was greatest with organic acid eluents and was more pronounced on Sephadex G-10 than on G-15. The difference in the elution volumes between NaI and $Na^{125}I$ could be decreased by elution with 0.1 M NaOH or by addition of NaI or KI to the loading sample. Sephadex G-25 did not appear to discriminate between NaI and $Na^{125}I$ under the conditions studied. (auth)

28615 THERMOGRAPHIC STUDY OF THE TERNARY SYSTEMS FORMED BY LITHIUM CHLORIDE, SODIUM CHLORIDE, POTASSIUM CHLORIDE, URANIUM TRICHLORIDE, AND URANIUM TETRACHLORIDE. Desyatnik, V. N.; Dubinin, B. V. J. Appl. Chem. USSR (Engl. Transl.); 48: No. 4, 923-925(Apr 1975).

Translated from Zh. Prikl. Khim.; 48: No. 4, 885-887(Apr 1975).

The experiments established that the ternary systems $LiCl-NaCl-UCl_4$ and $LiCl-KCl-UCl_3$ contain compositions with low melting points, which can be used as electrolytes for the preparation or purification of uranium by the electrolytic method. Fusion diagrams of the two systems are presented. (JGB)

28616 TRANSITION ELEMENTS. Sharp, D. W. A. (Glasgow Univ.). Annu. Rep. Prog. Chem., Sect. A; 71: 249-289(1974).

The subject is treated in two parts: Part I deals with general chemistry in sections entitled: group III (Sc), lanthanides (including references to Ce, La, Sm, Y, Yb, Pr, Tb, Nd, Lu, Ho, Eu) and actinides (including references to No, Cf, Th, U, Np, Pa, Pu); group IV (Ti, Hf and Zr); group V (V, Nb and Ta); group VI (Cr, Mo and W); group VII (Mn, Te and Re); the iron group (Fe, Ru and Os); the cobalt group (Co, Rh and Ir); the nickel group (Ni, Pd and Pt); group IX (Cu, Ag, Au); group X (Zn and Cd, Hg). Binary compounds and complex oxides and halides are covered under the appropriate elements in this part. Properties of ligands and properties that result mainly from the ligands are covered in Part II. (UK)

28617 SYNTHESIS OF ^{13}N LABELED ATMOSPHERIC GASES VIA PROTON IRRADIATION OF A HIGH PRESSURE OXYGEN TARGET. Parks, N. J.; Peek, N. F.; Goldstein, E. (Univ. of California, Davis). Int. J. Appl. Radiat. Isot.; 26: No. 11, 683-687(Nov 1975).

The bombardment of a 10 to 15 atm high purity O_2 target with a 5 to 10-μA beam of 15-MeV protons produces $^{13}N(t_{\frac{1}{2}} = 9.96$ min) by the $^{16}O(p,\alpha)^{13}N$ nuclear reaction. The nitrogen atoms are incorporated into the primary products, $^{13}N_2$, $^{13}N_2O$ and $^{13}NO_2$ in a ratio of 8:1:3.5 respectively. Cryogenic recovery of $^{13}NO_2$ under steady-state production conditions corresponds to 1 mCi/μA. The concentration of radiolytically produced carrier NO_2 is in the range of a 0.3 to 0.6 ppm. (auth)

28618 AUTORADIOGRAPHICAL STUDIES OF THE BEHAVIOR OF THE TRITIUM PRODUCED BY $^6Li(n,\alpha)^3H$ REACTION ON NICKEL. Takeuchi, T.; Takayasu, O.; Uchida, S.; Nakano, Y. Int. J. Appl. Radiat. Isot.; 26: No. 12, 736-740(1975).

The behavior of tritium produced on nickel by a $^6Li(n,\alpha)^3H$ reaction in the catalytic hydrogenation of ethylene was investigated by autoradiography using nickel plates which had preliminarily been covered with lithium and irradiated with neutrons. Two autoradiographical methods were used, the ordinary stripping-film method and the electron-microscope autoradiographical method. The autoradiographs given by the stripping-film method indicated that the grain boundaries which were not used in the catalytic reaction exhibited a much stronger radioactivity due to the tritium than did the grain; on the other hand, those which were used in the catalytic reaction behaved in just the opposite way. The electron-microscope autoradiographs indicated that tritium accumulated preferentially on the stepedges of the slip-band of the crystal. These findings enable us to conclude that the tritium in lattice imperfections is highly active in catalytic reactions. (auth)

28619 PRODUCTION OF RADIONUCLIDES AND LABELLED COMPOUNDS FROM ACCELERATORS. Servian, J. L. (International Atomic Energy Agency, Vienna). Int. J. Appl. Radiat. Isot.; 26: No. 12, 763-770(1975).

The present report prepared by a Consultants' Meeting convened by the International Atomic Energy Agency in May, 1974, deals with general and specific problems associated with the utilization of accelerators in nuclear medicine. The report is intended to serve as a guide for potential entrants in the field. The different types of accelerators are surveyed with indications of both positive and negative features. In addition, some of the attendant problems of radioisotope and radiopharmaceutical production are addressed. The report includes a set of conclusions and recommendations as well as a selected annotated bibliography. (auth)

28620 TRITIUM LABELLING OF 9,10-DIHYDROERGOTOXIN. Pleiss, U.; Zerjatke, W. Isotopenpraxis; 11: No. 12, 427-429 (1975).

A study was made to determine the optimum conditions for the tritium labelling of 9,10-dihydroergotoxin by the catalytic hydration of a mixture of ergocornine and ergokryptine. The parameters varied were the reaction temperature and reaction time. The radiolytic decomposition of the labelled product with time was also determined. (JSR)

28621 RAPID DEUTERATION AND TRIATION OF ORGANIC COMPOUNDS USING ORGANOMETALLIC AND ELEMENTAL HALIDES AS CATALYSTS. Long, M. A.; Garnett, J. L.; Vining, R. F. W. (Univ. of New South Wales, Kensington, Australia). J. Chem. Soc. (London), Perkin Trans., II; No. 12, 1298-1303(1975).

The use of ethylaluminium chloride and a range of other halides, such as $NbCl_5$, WCl_6, $SbCl_5$ and BBr_3, as catalysts for the rapid deuteration and tritiation of a variety of organic compounds is described in detail. In the deuterium exchange method [$^2H_6$] benzene is the isotope source and traces of water usually serve as a co-catalyst. But for maximum reproducibility very dry conditions with HCl as co-catalyst are recommended. The tritiation procedure involves the use of traces of high specific activity tritiated water to hydrolyze a complex of the catalyst with the organic substrate, tritium labelling accompanying the hydrolysis. These simple and rapid labelling methods are particularly suitable for aromatic compounds and their derivatives and to a lesser extent alkenes and some oxygen-containing organic compounds. The possible role of π-complex intermediates in these reactions is discussed. (auth)

28622 DECONTAMINATION EFFICIENCY OF COMMERCIAL DETERGENTS. Unger, H. Isotopenpraxis; 11: No. 12, 447-448 (1975).

The decontamination efficiency of seven commercial detergents manufactured in the German Democratic Republic was evaluated. The efficiency was evaluated as a function of the decontamination effects of pure water. The results obtained were tabulated. (JSR)

28623 STABILIZATION OF THE DAUGHTER SPECIES FOLLOWING THE AUGER EVENT IN SOME COBALT(III) CHELATES

IN DIFFERENT MATRICES. Srivastava, T. S.; Nath, A. (Univ. of Philadelphia). J. Phys. Chem.; 80: No. 5, 529-532(26 Feb 1976).

The emission Moessbauer spectra of $[^{57}Co(III)(phen)_3](ClO_4)_3 \cdot 2H_2O$ and $[^{57}Co(III)(bpy)_3](ClO_4)_3 \cdot 3H_2O$ dispersed in matrices of sucrose, poly(ethylene oxide), and the corresponding Fe(II) chelates were studied. The ratio of the Fe(II)/Fe(III) species stabilized varies from matrix to matrix. These observations have been interpreted on the basis of electron acceptor and donor centers. (auth)

28624 INVESTIGATION OF THE LANTHANIDE COMPLEXES OF PYRIDOXAL-AMINOACID AZOMETHINES BY OPTICAL METHODS. The Structure of Complexes Based on Hydrophobic Aminoacids. Zolin, V. F.; Koreneva, L. G.; Serbinova, T. S.; Tsaryuk, V. I. (Inst. of Radioengineering and Electronics, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 8, 1160-1163(Aug 1975).

Translated from Zh. Fiz. Khim.; 49: No. 8, 1980-1984(Aug 1975).

The structures of complexes of pyridoxal–aminoacid azomethines were studied by circular dichroic (CD), magnetic circular dichroic (MCD), and luminescence spectroscopic methods. Complexes of lanthanide (Pr^{3+}, Nd^{3+}, Eu^{3+}, Tb^{3+}, Er^{3+}, and Yb^{3+}) and certain other ions (UO_2^{2+}, Cu^{2+}, Zn^{2+}, Co^{2+}, and Fe^{3+}) were studied. The complexes comprise two ligand species and in those based on valine, leucine, and isoleucine the chromophores are almost perpendicular to one another. In the complexes based on glycine and alanine the coordination sphere is highly deformed. (JGB)

28625 DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS. Sax, N. I. Fourth Edition. Berkshire, Eng.; Van Nostrand Reinhold Co. (1975). 1258p. £21.25.

The new edition of this reference work contains a completely new theoretical part consisting of 11 sections devoted to: the historical perspective (legislation, general principles, TLVs); industrial air contaminant control (ventilation, other methods); industrial noise effects and control; effects of air environment in industrial facilities, etc.; radiation hazards (regulations, nature of radiation, permissible levels, radiation control, decontamination methods, etc.); large radiological sources and safeguards; hazards of solid-waste treatment; industrial fire protection (classification of fires, storage and handling of flammable materials, etc); industrial cancer risks (toxicity testing, chemoprophylaxis of chemical carcinogenesis by administering enzymes and other methods); toxicology; food additives; labelling and identification of hazardous materials. The remaining section, constituting the major part of the work, has been extensively revised. It provides data (general information; analysis of hazards, preventive measures) on over 12,000 hazardous materials, dealt with in alphabetical order. (CIS Abstr Vol 2)

Radioactive Waste Treatment

Refer also to abstracts 30392 and 32529.

28626 (ARH-ST-124) FIXATION OF RADIOACTIVE WASTE BY REACTION WITH CLAYS: PROGRESS REPORT. Delegard, C. H.; Barney, G. S. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Jul 1975. Contract E(45-1)-2130. 38p. Dep. NTIS $5.00.

Reactions of clay with Hanford-type radioactive wastes (liquids, salt cake, and sludge) were studied as a means of immobilization of radionuclides contained in the waste. Products of these reactions were identified as the crystalline sodium aluminosilicates, cancrinite and nepheline. Radionuclides are entrapped in these crystalline minerals. Conceptual flow diagrams for conversion of high-salt wastes to cancrinite and nepheline were defined and tested. The mineral products were evaluated for use as forms for long-term storage of radioactive waste. (auth)

28627 (ORNL/TM-5095) KRYPTON ABSORPTION IN LIQUID CO_2 (KALC): CAMPAIGN II IN THE EXPERIMENTAL ENGINEERING SECTION OFF-GAS DECONTAMINATION FACILITY. Glass, R. W.; Beaujean, H. W. R.; Fowler, V. L.; Gilliam, T. M.; Inman, D. J.; Levins, D. M. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 55p. Dep. NTIS $5.50.

Results are presented for the second major campaign for quantifying krypton removal from simulated High-Temperature Gas-Cooled Reactor reprocessing off-gas by the KALC process. The Experimental Engineering Section Off-Gas Decontamination Facility used in the campaign provides engineering-scale experiments with nominal gas and liquid flows of 5 scfm and 0.5 gpm respectively. Equilibrium and nonequilibrium mass transfer experiments for the CO_2–O_2–Kr system are described, and a detailed discussion of the data analysis is included. The analysis, although not rigorous, is reasonable and indicates values of HTU for krypton on the order of 0.4 ft for decontamination factors from 100 to 10,000. Recent flooding information for the packed columns is combined with previous data and is shown to be well represented by an empirical flooding equation. (auth)

28628 (UCRL-77735) SEPARATION OF TRIVALENT LANTHANIDES AND ACTINIDES BY SOLVENT EXTRACTION WITHOUT AQUEOUS COMPLEXING AGENTS. Kasting, G. B.; Heppert, J. A.; Hulet, E. K.; Wild, J. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jan 1976. Contract W-7405-Eng-48. 7p. (CONF-751233-1). Dep. NTIS $3.50.

From JOWOG 20 meeting; Los Alamos, New Mexico, United States of America (USA) (8 Dec 1975).

A method of separating the trivalent actinides, mainly Am and Cm, from trivalent lanthanides is presented. This method embodies the sequential use of two different solvent extractants; the first extractant would remove the heavy lanthanides from the lighter lanthanides and Am–Cm, while the second would extract Am-Cm in preference to the lighter lanthanides. In this scheme, no additional complexing agents are required. Thus, waste disposal and corrosion problems are minimized. Overall separation factors for Am–Cm from lanthanide fission products in reactor wastes may be as high as several thousand. (auth)

28629 HANDLING AND DISPOSAL OF RADIOACTIVE SCRAP. Review of a Special Course for Journalists. Witte, K. At. Strom; 21: No. 9/10, 115-119(Sep 1975). (In German)

4 figs.

The 9th special course for journalists was in this year on the highly topical subject "handling and disposal of radioactive scrap." It was held on the 26th and 27th, May 1975 at the Nuclear Research Center at Karlsruhe. These courses have been held for several years by the Nuclear Research Association (GfK) in the School for Nuclear Engineering and are intended mainly to contribute to journalists of the daily papers, radio and television who are "not previously technically trained" an introduction into the difficult subject matter of nuclear engineering with its ancillary areas. In view of the many discussions carried on in public the course is further intended to achieve that the problems discussed are treated by means of publicity which is free from emotion. In the journalists' course this year specially selected experts gave technical information prepared for general information as to how radioactive waste can be safely worked up and then finally stored without adverse effects on the environment. The separate subjects on which lectures were given are reported. (DE)

28630 PROCEDURE OF SEPARATING DECAY AND CORROSION PRODUCTS AND RELATED STABLE ISOTOPES FROM LIQUID WASTES. Prochazka, H.; Jilek, R.; Stamberg, K.; Hulak, P.; Katzer, J. (to Ceskoslovenska Komise pro Atomovou Energii, Prague). German (FRG) Patent 107355/D/. 20 Jul 1974. 4p. (In German)

German Democratic Republic Cl. 21g21/33.

The use of microorganismic mycelia solidified by resins for adsorption of decay and corrosion products is described along with the combustion of contaminated bioadsorbents. (GC)

28631 METHOD OF SEPARATION AND RECOVERY OF KRYPTON AND XENON NUCLIDES FROM EXHAUST GASES. Kronauer, P.; Juentgen, H.; Schroeter, H. J. (to Bergwerksverband G.m.b.H., Essen (F. R. Germany)). German (FRG) Patent 2343313/A/. 13 Mar 1975. 10p. (In German)

The method uses activated carbon as adsorption medium for ^{85}Kr and Xe isotopes in waste gases. The activated carbon is flowed through at normal pressure and temperature until the breakthrough of the Kr. The adsorber is regenerated in three steps. The first consists of an evacuation at a pressure between 10 and 50 mm Hg and at constant temperature as well as the addition of desorption gases to the waste gas. The second step involves a counter-current washing with inert gas at a pressure under 760 mm Hg and at a temperature of 150°C where a Kr and Xe enriched gas fraction of the product gas is kept. As soon as the washing gas exhibits a Kr and Xe concentration corresponding to the concentration in the impure waste gas, a second washing gas fraction is removed. This is introduced into the non-purified starting gas. A third step follows, which is a recycling of the adsorption medium to the pressure of the adsorption medium to the pressure of the adsorption step by suction or pressing an inert gas, e.g. air. In the regeneration step (stage 2), the gas products can be freed from the washing gas by condensation or freezing out. (DE)

28632 PHYSICO-CHEMICAL PRINCIPLES AND CALCULATION OF PROCESSES USED TO EVAPORATE HIGHLY-ACTIVE NITRIC ACID SOLUTIONS. Efimov, A. N.; Zhikharev, M. I.; Zhirnov, Yu. P. At. Energ. (USSR); 39: No. 6, 416-419(Dec 1975). (In Russian).

To substantiate optimum evaporation flowsheets for highly active nitric acid solutions prior to their burial a study was made of the liquid-vapor equilibrium in systems of nitric acid–water–nitrate. Sodium, copper, beryllium, nickel, chromium, lanthanum, iron, and aluminum nitrates are shown to "salt out" the nitric acid into a vapor phase. The salting out effect of a nitrate mixture as expressed in terms of logarithms of improvement factor is approximately additive. A graphical-analytical method is proposed to calculate the evaporation process in evaporators with a purification column, taking into account the effect of the latter on the nitric acid distribution. (auth)

28633 LABORATORY STUDIES OF THE TREATMENT OF LIQUID WASTE STREAMS FROM URANIUM MILLING OPERATIONS. Ryan, R. K.; Alfredson, P. G. (Australian Atomic Energy Commission, Lucas Heights). Australas. Inst. Min. Metall. Proc.; No. 253, 25-34(Mar 1975).

Neutralization with lime is a simple, cheap, and effective means of treating acid raffinates from uranium processing to raise the pH, reduce the concentrations of dissolved salts (including heavy metal impurities), and remove amine by adsorption. Two-stage neutralization, using limestone in the first stage at approximately pH 4 and lime in the second, may be advantageous. Lime neutralization of raffinates in the pH range 7 to 8.5 generally reduced the radium concentration to 10 to 200 pCi l^{-1}, but there was considerable scatter in the experimental data. The radium concentration was further reduced to less than 3 pCi l^{-1} by coprecipitation of barium (radium) sulfate with 10 mg Ba (as barium chloride) per liter of raffinate. Adsorption of radium on barytes was also effective in reducing the radium concentration in neutralized raffinate to less than 3 pCi l^{-1}. The radium concentration of pit water was readily reduced to less than 3 pCi l^{-1} when pit water containing 0.01 M sulfate as ammonium, calcium, or sodium sulfate was treated with 20 mg Ba per liter of pit water. Adsorption on barytes was also effective in removing radium from pit water containing 0.03 M sulfate. (auth)

28634 EFFECT OF AMMONIA ON THE ADSORPTION OF KRYPTON AND XENON ON SKT-M CARBON. I. Determination of Adsorption Isotherms of Ammonia and of Static Equilibrium Adsorption Coefficients of the Inert Gases. Rozhdestvenskaya, L. N.; Cherapov, A. G.; Keier, B. R.; Chechetkin, Yu. V.; Kizin, V. D. Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 6, 880-882 (Jun 1975).

Translated from Zh. Fiz. Khim.; 49: No. 6, 1497-1499(Jun 1975).

Adsorption isotherms have been determined for ammonia vapor on SKT-M carbon under dynamic conditions for sorbate concentrations up to 100 mg/liter between 40 and –28°C. The effects of concentration and the adsorption of ammonia at temperatures from 40 to –20°C on the static equilibrium adsorption coefficients of krypton and xenon have been studied. (auth)

28635 EFFECT OF AMMONIA ON THE ADSORPTION OF KRYPTON AND XENON ON SKT-M CARBON. II. Determination of the Equilibrium Adsorption Coefficients of the Inert Gases Under Dynamic Conditions. Rozhdestvenskaya, L. N.; Cherepov, A. G.; Keier, B. R.; Chechetkin, Yu. V.; Kizin, V. D. Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 6, 882-884(Jun 1975).

Translated from Zh. Fiz. Khim.; 49: No. 6, 1500-1502(Jun 1975).

The effect of ammonia on the sorption of krypton and xenon on the industrial carbon SKT-M has been studied under dynamic conditions between 40 and –28°C. A formula was proposed for calculating the sorption coefficients of the inert gases in the presence of ammonia over the concentration and temperature ranges of practical importance. (auth)

28636 NEW PROCEDURES FOR PROCESSING RADIOACTIVE WASTES IN NUCLEAR ENGINEERING PLANTS. Friedrich, R. (Werner und Pfleiderer Maschinenfabrik, Stuttgart (F.R. Germany)). pp 469-484 of Waste Gas–Waste Water–Solid Wastes. Lectures. Behrens, D.; Fischbeck, K. (eds.). Weinheim/Bergstr., F.R. Germany; Verl. Chemie (1974). (In German).

From European meeting on chemical engineering and ACHEMA congress; Frankfurt am Main, F.R. Germany (20 Jun 1973). 13 figs.; 2 tabs.; 10 refs.

The extent to which radioactive wastes are produced during nuclear engineering processes and the techniques used to eliminate such wastes in order to avoid contamination of the biosphere are discussed. The most up-to-date method which has been realized in industry several times is described in detail. A fully automatic process has been developed on the basis of mixers and driers with self-cleaning screw systems, which ensures a uniform quality of the final product in conjunction with minimum temperature load and as short a residence time as possible. Maximum safety during transport and storage and for the operating personnel is guaranteed. (DE)

28637 THE EMBEDDING OF DISSOLVED INDUSTRIAL POISONS AND ISOTOPE WASTES IN BITUMEN. Magyar, M.; Mozes, G. (Magyar Asvanyolaj es Foldgaz Kiserleti Intezet, Veszprem). pp 495-504 of Waste Gas–Waste Water–Solid Wastes. Lectures. Behrens, D.; Fischbeck, K. (eds.). Weinheim/Bergstr., F.R. Germany; Verl. Chemie (1974). (In German).

From European meeting on chemical engineering and ACHEMA congress; Frankfurt am Main, F.R. Germany (20 Jun 1973). 5 figs.; 3 tabs.

A technique for embedding dissolved industrial poisons and liquid radioactive wastes in bitumen has been developed by the Hungarian Oil and Gas Research Institute. A continuous and discontinuous plant for this purpose has been realized in practice, and its more important technical features are assembled. Given a knowledge of the nature and quantities of the waste products concerned, installations of the desired capacity and performance can be designed with the aid of the preliminary process already developed and this Institute promised to advise on such matters. (DE)

28638 TREATMENT OF RADIOISOTOPES IN THE DISCHARGE WATER COMING FROM A MODERN NUCLEAR MEDICINE DEPARTMENT. Ottaviani, M. (Istituto Superiore di Sanita, Rome (Italy)); Zanchi, F. Ingegnere (Rome).; 49: No. 11, 435-510(Nov 1974). (In Italian)

A treatment is proposed for the biological wastes coming from a nuclear medicine center with a 40 sick people capacity. For the waste processing, a flocculation is suggested followed by a second phase of ion exchange. The engineering problems for a practical application are also examined. (INIS)

28639 TRAPPING AND RECOVERY OF RADIOIODINE COMPOUNDS BY COPPER METAL. Tachikawa, E.; Tanase, M.; Motojima, K. (Japan Atomic Energy Research Inst., Tokai). Int. J. Appl. Radiat. Isot.; 26: No. 12, 758-762(1975).

The performance of Cu metal as an adsorbent for volatile radioiodine compounds, I_2^*, HI* and CH_3I^* has been examined. Both I_2^* and HI* are effectively trapped. However, for the complete trapping of organic iodide, a process converting it into inorganic form must precede the trapping process. The iodine, trapped on the reduced Cu, is easily released as HT* by a stream of H_2 gas above 400°C. Compared to other conventional procedures, this trapping procedure has the advantage that Cu is regenerated during the recovery process to be used again. (auth)

28640 STUDIES ON THE BITUMINIZATION PROCESS OF RADIOACTIVE LIQUID WASTE. I. Lee, S. H. (Korea Atomic Energy Research Inst., Seoul); Chun, K. S.; Lim, E. K. J. Korean Nucl. Soc.; 7: No. 3, 213-222(Sep 1975).

A method for immobilization of the second-cycle radioactive liquid wastes from a Purex process was developed with blown asphalt to eliminate the possibility of redispersion of the radioactive materials into the environment. Attempts to incorporate these wastes directly into the asphalt martrices without any pretreatment were not successful, the sulfuric acid in the waste oxidized the asphalt. Hence, the waste was treated with caustic soda and made alkaline prior to bituminization. This pretreatment made the waste compatible with the asphalt matrices. The pure blown asphalt samples irradiated with doses of 4.0×10^7 rad showed no evidence of volume increase. The suitable temperature for incorporation of the alkaline wastes into blown asphalt was 180–200°C. The products containing 50 wt % salts had good volume reduction (about 1.4), homogeneity, leachability, etc. During the period of 131 days ^{137}Cs from products containing 40 wt % salts was leached at rates ranging from 2.70×10^{-4} to 8.27×10^{-4} g/cm^2-day, but the rate for ^{90}Sr was lower by one to two orders of magnitude by distilled water. The leaching rates for ^{137}Cs and ^{90}Sr by sea water were slightly lower than by distilled water. Both of the leaching rates decreased with increasing pH. (auth)

28641 TRANSURANIC SOLID WASTE TREATMENT STUDIES AT LOS ALAMOS. Hildner, R. A.; Borduin, L. C.; Draper, W. E.; Warner, C. L. (Los Alamos Scientific Lab., NM). Conf. Remote Syst. Technol., Proc.; 23: 270-277(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

Various contaminated solid waste reduction processes will be studied in the LASL Transuranic Waste Treatment Development Facility (TDF). Controlled air incineration will be the initial reference process. Incineration has not proved satisfactory in the past due to technical problems including equipment sealing, maintenance, and off-gas cleanup. This paper outlines the techniques being developed to provide a successful incineration system for use when the processing line is ready for operation in mid-1976.

Radioisotope Production

Refer also to abstracts 28400 and 31230.

28642 RADIONUCLIDE GENERATOR AND PROCEDURE FOR ITS PREPARATION. Brown, J. L.; Harris, O. A. (to Mallinckrodt Chemical Works, Weldon Spring, Mo. (USA)). German (FRG) Patent 103082/D/. 5 Jan 1974. 12p. (In German)

German Democratic Republic Cl. 21g21/12.

A radionuclide generator for preparing technetium-99m eluates free from aluminium ions is described. The procedure utilizes a chromatographic aluminium oxide column with adsorbed molybdate ions carrying ^{99}Mo, activation of aluminium oxide, and washing by a fixing solution. (GC)

28643 TARGET MATERIALS FOR THE CYCLOTRON PRODUCTION OF CARRIER-FREE ^{77}Br. Nunn, A. D.; Waters, S. L. (Hammersmith Hospital, London). Int. J. Appl. Radiat. Isot.; 26: No. 12, 731-735(1975).

A comparison is made between arsenic pentoxide, arsenic trioxide and arsenic metal as target materials for the cyclotron production of ^{77}Br by the ^{75}As(α, 2n) ^{77}Br reaction. Theoretical thick target yields are calculated. A method of producing ^{77}Br is described which is more reliable and has given a higher production rate than the previously published method. (auth)

28644 DRY DISTILLATION SEPARATION OF CARRIER-FREE ^{131}I FROM REACTOR IRRADIATED Mg_3TeO_6. Toth, G.; Repas, L.; Fabian, G. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). Int. J. Appl. Radiat. Isot.; 26: No. 12, 781-782(1975).

The preparation of ^{131}I by dry distillation following the reactor irradiation of Mg_3TeO_6 is reported. This target material shows high thermal and radiation stability and may be heated to temperatures up to 880°C. The low cross-section of Mg(0.06 barn) makes the parasitic neutron capture negligible. The percentage of ^{131}I released from the target, after 300 hr irradiation at a flux of 2.5×10^{13} n/cm^2/sec, in 15 min at different temperatures is shown graphically. It is shown that the release rate becomes considerable around 600°C. The method has been used for the routine production of ^{131}I at a multi-curie level. (UK)

28645 PREPARATION OF CARRIER-FREE ^{28}Mg BY MEANS OF PHOTONUCLEAR REACTIONS. Yagi, M. (Tohoku Univ., Sendai); Yamadera, A.; Fujikawa, S.; Shiokawa, T. Int. J. Appl. Radiat. Isot.; 26: No. 11, 637-639(Nov 1975).

The ^{30}Si(γ,2p)^{28}Mg reaction has proved to be useful for the preparation of a low-level activity of carrier-free ^{28}Mg. The production rates at 30, 45, and 60 MeV were determined, and the chemical separation was studied. The production rate at 60 MeV at an average electron-beam current of 220 μA was 320 m μCi/g of natural silicon metal per hr of irradiation. (auth)

28646 ON THE ACTIVITY OF THE ISOTOPE LABORATORY IRRADIATION SERVICE AND TRACET LABORATORY. Noppel, H. E.; Wolf, P. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie). KFK Nachr.; 7: No. 2, 28-30 (Jul 1975). (In German)

2 figs.; 1 tab.

The isotope laboratory is a working group in the Radiochemistry Institute. Their task is the preparation of radionuclides by irradiation in the FR 2 or in the cyclotron, supply, dispatch and distribution of radioactive materials in the center and to external customers, labelling of organic compounds and chemical processing or irradiated targets to obtain special fission products. The isotope laboratory was founded in 1960 as the central group to supply all institutes with radioactive materials in the research center and is entrusted with the storage and subdivision of these substances within its equipment. (DE)

28647 USE OF ALUMINA AS AN ION EXCHANGER IN THE SEPARATION OF CARRIER-FREE ^{140}La FROM ^{140}Ba. Bhattacharyya, D. K.; Basu, S. (Saha Inst. of Nuclear Physics, Calcutta). Sep. Sci.; 11: No. 1, 103-108(1976).

Radiochemical separation of carrier-free ^{140}La from ^{140}Ba has been performed by adsorbing the barium separately as sulfate and chromate in a powdered alumina column while lanthanum was eluted out. In both cases the adsorbed barium activity was later washed out with hot dilute nitric acid. Radiochemical purity of the separated lanthanum product was ascertained through beta-decay studies. (auth)

28648 QUICK SPECTROGRAPHIC METHOD FOR SEMI-QUANTITATIVE ANALYSIS OF RADIOACTIVE IODINE. Abou El-Nour, F. Isotopenpraxis; 11: No. 11, 393-395(1975).

The need for quick and accurate determination of trace but harmful impurities in radioactive iodine, to be used for medical purposes, led to the establishment of a spectrographic method of analysis using the copper-spark technique and based on the disappearing spectral line intensity principle. The least amounts of the relevant trace elements of harmful effect namely, Al, As, Ba, Be, B, Cd, Cr, Co, Fe, Pb, Mg, Mn, Hg, Ag, Na, Ni, Sn, and Te, which are permissible have been found, by determining the intensities of the spectral lines which just appear at such concentrations. The degree of purity of the radioactive iodine found spectrographically determines whether it is to be used for clinical or industrial purposes. Studies on the parameters governing the process of excitation in the spark plasma as well as the surface flatness of electrodes enabled achieving such high reliability in selection control.

28649 INFLUENCE OF ZIRCONIUM IONS ON THE SORPTION OF CARRIER-FREE RADIOPHOSPHATE (^{32}P). Friedmann, C.; Schoenfeld, T. Isotopenpraxis; 11: No. 12, 419-421(1975).

The addition of zirconium ions largely affects the sorption of carrier-free radiophosphate in acidic solutions on various materials. The addition of small quantities of zirconium with some sorbents, such as diatomeceous earth, clay minerals or activated charcoal present, leads to a substantial increase of ^{32}P adsorption. On the other hand, important quantities of zirconium cause decrease of sorption. With alumina as an adsorbent, any addition of zirconium leads to reduced adsorption of radiophosphate. These phenomena are based on the formation of soluble zirconium-phosphate complex ions.

28650 PRODUCTION OF ^{52}Fe FOR USE IN NUCLEAR MEDICINE. Lindner, L.; Diemer, E. L.; Kapteyn, J. C. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Ned. Tijdschr. Geneesk.; 119: No. 44, 1743-1744(1 Nov 1975). (In Dutch).

From Conference of the Dutch Society of Nuclear Medicine; Utrecht, Netherlands (21 Feb 1975).

28651 STUDY OF ^{87m}Sr. Veglia, A. (AIEA, Seibersdorf, Austria). J. Radioanal. Chem.; 29: No. 1, 129-143(1976). (In French)

A method is proposed for the determination of chemical and radionuclidic purity of ^{87m}Sr generator eluates. Two generators of different origins have been studied. The presence of the radionuclides ^{87}Y, ^{85}Sr, ^{88}Y, ^{60}Co, ^{58}Co has been shown in the eluates. Fe and Sr were not found in the eluates in concentrations higher than 10 mg/l and 100 mg/l, respectively. A recommendation is made for the use of these generators. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 28272 and 28278.

28652 (INIS-mf-1966/8) REPROCESSING OF FUELS. Levin, I. (Israel Nuclear Society, Yavne). 1975. 5p. (In Hebrew). INIS.

From symposium on nuclear fuel in Israel; Rehovot, Israel (1 Jul 1975).

The reprocessing of fuel in a PWR type reactor is described. The causes which render difficult the otherwise easy chemical process are shown. Fission products effects, waste disposal and storage are examined and present and future solutions to the problem are discussed. (INIS)

28653 (K-GD-1390) FLUOROCARBON ABSORPTION PROCESS FOR THE RECOVERY OF KRYPTON FROM THE OFF-GAS OF FUEL REPROCESSING PLANTS. Stephenson, M. J.; Eby, R. S.; Pashley, J. H. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 28 Jan 1976. Contract W-7405-eng-26. 13p. Dep. NTIS $4.50.

Recent progress in the development of a fluorocarbon adsorption process for the recovery of krypton from the off-gas of fuel reprocessing plants is reported. Three packed columns comprise the main working sections of the process. Each column is designed to exploit certain gas-liquid solubility differences that exist between the solvent and the various gas constituents that might be present. The main separation of noble gas is accomplished in the absorber. The other two columns, each fitted with a reboiler and an overhead condenser, comprise the intermediate and final stripper sections of the plant. (LK)

28654 UNITED REPROCESSORS' ARRANGEMENTS FOR STORAGE AND REPROCESSING OF IRRADIATED FUEL FROM POWER REACTORS. Reprocess. Newsl.; 4: 2-4(Jun 1974).

United Reprocessors are of the opinion that the European demand for reprocessing can be covered despite the numerous technical, financial, and commercial problems yet to be solved, on the condition that new safety requirements and conditions do not lead to extensive delays. Considering the exceptionally high investments to be transacted, a financial support from the customers will be necessary. It is expected that in the second half of the 80's, reprocessing plants will be built with the technical support of United Reprocessors in other countries. (DE)

CONTROLLED THERMONUCLEAR RESEARCH

Refer also to abstract 31230.

28655 (EUR-5064) INTERNATIONAL SCHOOL OF PLASMA PHYSICS COURSE ON INSTABILITIES AND CONFINEMENT IN TOROIDAL PLASMAS. Varenna (Italy), September 27–October 9, 1971. (Commission of the European Communities, Luxembourg). Nov 1974. 472p. INIS.

From international school of plasma physics. Course on instabilities and confinement in toroidal plasmas; Varenna, Italy (27 Sep 1971).

The lectures of a Varenna Summer School about the theme instabilities and confinement in toroidal plasmas are given. The topics included are: high-beta toroidal pinches, non-MHD instabilities and anomalous transport, analogy between turbulent transfer in velocity space and plasma collision transport in real space, the magnetohydrodynamic approach of plasma confinement in closed magnetic configurations, properties of isodynamical equilibrium configurations and their generalization, transport theory for toroidal plasmas, plasma physics, low-β toroidal machines, the neoclassical theory of transit time magnetic pumping, radio frequency heating of toroidal plasmas, plasma heating at lower hybrid frequency, Rf-plasma heating with L-structures, numerical simulation, dynamical stabilization of low frequency waves in inhomogeneous plasmas, dynamic and feedback stabilization of plasmas and problems with nuclear fusion reactors. (INIS)

Plasma Confinement and Heating

Refer also to abstract 28655.

28656 (EUR-5236) PRESENT STATE OF RESEARCH INTO PLASMA HEATING AND INJECTION METHODS. (Commission of the European Communities, Luxembourg). Dec 1974. 130p. INIS.

The advantages and disadvantages recognized by the Advisory Group on Heating and injection for twelve plasma heating and injection methods currently under investigation in Europe are related. The heating and injection requirements of four reference reactor designs are previously defined. The problems which arise when one attempts to extrapolate existing work towards the reactor goal are emphasized. Two refuelling methods not directly linked with the heating problem are discussed. The experiments in operation or under construction in Europe in which each method is investigated are listed. Sixteen working papers which served as a basis for the Advisory Group discussion and which cover all the heating and injection methods examined are included.

28657 (EUR-CEA-FC-783) IMPURITY EVOLUTION IN TFR PLASMAS. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Aug 1975. 13p. INIS.

From 7th European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

Space and time resolved profiles of impurities have been obtained in TFR plasmas by a shot-to-shot scan. Light impurities are present at the very beginning of the discharge, resulting in Z(eff) = 4 already at a time of 7 msec. On the current plateau, light impurity ions and heavy impurity ions of moderate charge are concentrated at radii where the electron temperature is equal or slightly smaller than their ionization potential, and radiate about 35% of the input power. Inwards diffusion velocities of about 2×10^3 cm/sec are deduced for a radius of about 16 cm. Highly ionized molybdenum ions (Mo^{30+}, Mo^{31+}) are concentrated inside a radius of about 10 cm, with a density of about 10^{11} cm^{-3}. This paper mainly describes a study of the visible and ultraviolet radiation in TFR deuterium discharges with a plasma current I_p = 140 kA and a toroidal magnetic field B_T = 26 kG (diaphragm diameter 40 cm). (FR)

28658 NUMERICAL SOLUTION OF THE PLANE BOUNDARY-VALUE PROBLEM OF LASER HEATING OF TWO-TEMPERATURE PLASMA WITH RECOVERY OF THE ENERGY OF NUCLEAR FUSION. Kaliski, S.; Kaminski, B. Proc. Vib. Probl.; 15: No. 2, 91-103(1974).

The heating of two-temperature plasma was analyzed with particular emphasis on distribution of fields, separation points, the influence of the fusion energy on the form of the fields, relaxation effects and equalization of the differences of temperatures. It was established that the front of the perturbation wave is first thermal then, after separation, a shock wave front. It is followed by the shock wave front produced by the pressure acting on the boundary. The shock wave front depends on the dynamic and thermal parameters of ions. If the temperature of ions exceeds the critical value of the temperature, at which there is rapid production of fusion heat, there is rapid equalization between the ion and electron temperature and between the temperature at the boundary and at the wave front.

28659 INVESTIGATIONS OF ANOMALOUS PROCESSES ASSOCIATED WITH THE LOWER HYBRID WAVES. Chu, C. Princeton, NJ; Princeton Univ. (1974). 143p. University Microfilms Order No. 75-20,621.

Thesis (Ph. D.).

Some plasma phenomena associated with the lower hybrid wave are investigated by means of 2-½ D computer experiments. Under the modest condition omega/sub ce/ approximately omega/sub pe/, which occurs in many fusion-oriented devices, it is found that the electron transport rates (heat and momentum) are much enhanced above the classical collisional values even for plasmas very close to thermal equilibrium. The enhancement is due to electron turbulent motion in the field of thermally excited lower hybrid waves. Employing a fluid model and by including a turbulent viscous term in the electron momentum equation, linear theory gives predictions which are in reasonably good agreement with the observed lower hybrid wave damping. Existing strong turbulence plasma theories give predictions which are not in agreement with the observations. In the presence of a long wavelength, large amplitude pump wave with a frequency close to the lower hybrid frequency, the plasma is subject to parametric instabilities. The parametric decay instability is associated with the excitation of a short wavelength ion acoustic wave and a short wavelength lower hybrid wave. During the initial stages, the unstable daughter waves propagate in a small cone about the direction of the pump-induced $E_0 \times B_0$ drift. With the development of the instability, the spectrum spreads in angle and creates two-dimensional turbulence. The electrons are anomalously heated in the direction parallel to the magnetic field, while the ions are heated in the perpendicular direction. Cross-field transport of particles and energy in the presence of turbulence is discussed and test electron transport is found to be strongly enhanced. Because of the low threshold and high heating efficiency, this instability could play an important role in the supplementary rf heating for a fusion plasma at the low hybrid frequency. (Diss. Abstr. Int., B)

28660 THERMONUCLEAR SYSTEMS BASED ON A THETA-PINCH WITH A COLLAPSIBLE LINER. Turchi, P. J. Zh. Prikl. Mekh. Tekh. Fiz.; No. 4, 32-44(1975). (In Russian).

Compression of a magnetic flux by a liner can be used to create and confine a thermonuclear plasma in megagauss magnetic fields, by means of which it is possible to make a compact reactor of rather moderate energy. These systems include in themselves a conducting cyclinder or liner, which compress the initial magnetic flux to create strong magnetic fields. If the dense plasma ($\beta \approx 1$) is contained by the initial magnetic field, it also will be compressed by the liner, and will acquire a high temperature and pressure. The theoretical problem of thermonuclear studies involving a compressible liner is to find a combination of nonexplosive methods of compressing the liner with configurations of plasma and magnetic field possessing suitable simplicity and stability in order to obtain an efficient and safe reactor with repeated pulses. Plasma losses from the ends can be decreased by special magnetic configurations. This article considers a linear theta-pinch with anti-stoppered sections on the ends. (SJR)

28661 NUMERICAL MODEL OF PLASMA CONFINEMENT. Sprott, J. C.; Strait, E. J. (Univ. of Wisconsin, Madison). IEEE Trans. Plasma Sci.; PS-4: No. 1, 6-10(Mar 1976).

A time-dependent, zero-dimensional computer model with no adjustable parameters, for magnetically confirmed plasmas, is described. It predicts spatially averaged values of plasma density and electron and ion temperatures, and its predictions compare well with volume averaged measurements made in the Wisconsin Levitated Toroidal Octupole. The model is easily adaptable to predict scaling in other devices.

28662 TRAPPING OF CHARGED PARTICLES BY WAVE PACKETS IN A COLLISIONLESS DISPERSIVE MEDIUM.

Davydovskii, V.Y.; Sapogin, V.G.; Ukolov, A.S. (Taganrog Radiotechnical Institute). Sov. Phys.—Tech. Phys. 20: No. 8, 1020-1023 (Aug 1975).

Conditions are obtained for the trapping of a charged particle by a single plane linearly polarized electromagnetic pulse of slowly increasing amplitude. The increase in amplitude is due to the compression of the pulse in a dispersive medium. For a medium whose particles have a Maxwellian distribution an expression is found for the number of particles trapped per unit area of the pulse front per unit time. Numerical estimates are given for a homogeneous plasma and a stratified plasma. (auth)

28663 THE ROLE OF HIGH-FREQUENCY PREIONIZATION IN IMPROVING PLASMA HEATING. Fedyakova, V.P. (D. E. Efremov Scientific Research Institute of Electrophysical Instrumentation). Sov. Phys.—Tech. Phys. 20: No. 8, 1043-1044 (Aug 1975).

The possibility of improving turbulent plasma heating by rf preionization is considered. It is shown that preionization with an hf current of 1.2 kA makes it possible to obtain a detached pinch with a density $n = 2 \cdot 10^{14}$ cm^{-3} and a gas kinetic pressure $nT = 10^6$ eV·cm^{-3}. Hf preionization gives an order of magnitude improvement in plasma heating with a ringing circuit. The dependence of heating efficiency on the amplitude and frequency of hf current is indicated. (auth)

28664 HIGH-CURRENT PINCHES IN XENON. I. Θ PINCH. Andreev, S.I.; Baikov, O.G.; Dashuk, P.N.; Popov, P.G. Sov. Phys.—Tech. Phys. 20: No. 8, 1105-1109 (Aug 1975).

In a study of xenon pinches at initial pressures from 1 to 100 torr, energies up to 10 kJ, and discharge voltage up to 50 kV in cylindrical quartz chambers up to 10 cm in diameter it has been found that the initial plasma contraction velocity is proportional to the discharge voltage and inversely proportional to the square root of the gas density. Under conditions such that the shock-wave velocity reaches 6–10 km/sec, there is a discharge regime with a highly emitting, current carrying shock wave. Analysis of the energy balance of the discharge shows that the radiative energy loss rapidly increases in importance as the shock-wave velocity and the gas density increase. At an initial xenon pressure of a few torr, plasma temperatures up to 60 000 °K and a brightness temperature in the visible region of the order of 20 000 °K have been observed. The ignition voltage can be determined sufficiently accurately from the experimental curves in the literature obtained in rf breakdown. (auth)

28665 MEASUREMENT BY A MIRROR PROBE METHOD OF THE ANISOTROPY OF THE ELECTRON DISTRIBUTION FUNCTION OF AN AFTERGLOW PLASMA CONFINED IN A MAGNETIC MIRROR FIELD. Yamamoto, N.; Hatta, Y. (Department of Electronic Engineering, Faculty of Engineering, Tohoku University, Sendai, Japan); Aikawa, H.; Ikegami, H. Phys. Rev. A 13: No. 4, 1543-1547 (Apr 1976).

The anisotropy of the electron distribution function of an afterglow plasma produced in a microwave discharge and confined in a magnetic mirror field is studied with the use of a mirror probe method. It is found that the observed distribution indicates the characteristics of the loss-cone distribution function. (auth)

28666 TRANSITION FROM PARTICLE TRAPPING TO A QUASI-LINEAR-LIKE BEAM-PLASMA SYSTEM. Jones, R.; Carr, W.; Seidl, M. (Department of Physics, Stevens Institute of Technology, Hoboken, New Jersey 07030). Phys. Fluids 19: No. 4, 548-553 (Apr 1976).

Experimental observations show that the beam-plasma instability generates a modified beam distribution function which can destabilize new modes. These sideband modes nonlinearly saturate, modify the beam further, and a cascade proceeds. For strong beams the cascade and attendent phase mixing lead to a quasilinear-like spectrum of waves and a nearly plateau-like beam. For absolute instability, the approach to a quasilinear system is slower than for the convective instability because the spectrum is fundamentally discrete. (auth)

28667 EVIDENCE OF LOCALIZED HEATING IN CO_2-LASER-PRODUCED PLASMAS. Haas, R.A.; Boyle, M.J.; Manes, K.R.; Swain, J.E. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). J. Appl. Phys. 47: No. 4, 1318-1321 (Apr 1976).

Polyethylene foils and parylene disks have been irradiated by CO_2 ($\lambda \sim 10.6$ μm) and Nd : YAG-glass ($\lambda \sim 1.06$ μm) laser pulses focused to flux levels in the 10^{13}- and 10^{14}-W/cm^2 range. X-ray pinhole photographs of the CO_2-laser-produced plasmas exhibit intense localized emission regions whose characteristic dimensions are smaller than the nearly diffraction-limited focal spot of the laser. Corresponding photographs of the glass-laser-produced plasmas show no evidence of localized emission. These experimental results are consistent with theoretical predictions for laser-beam trapping and/or filamentation in laser-produced plasmas. (auth)

28668 ENERGY DEPOSITION IN LASER-HEATED PLASMAS. Brueckner, K.A. (Department of Physics, University of California, San Diego, La Jolla, California 92903). Phys. Rev. Lett. 36: No. 12, 677-679 (22 Mar 1976).

The number and energy distribution of suprathermal electrons produced in a laser-heated plasma can be quantitatively obtained directly from the experimental x-ray spectrum with only the assumption that the fast electrons lose energy by bremsstrahlung and electron-electron collisions. The result is independent of the spatial and temporal distribution of electron density and temperature. (auth)

Plasma Diagnostics

Refer also to abstracts 28668, 28728, 28777, and 29217.

28669 (EUR-CEA-FC-775) NEW LOCAL MEASUREMENT METHOD OF EFFECTIVE CHARGE AND IONIC DENSITY IN TOKAMAK. DeiCas, R. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Aug 1975. 23p. (In French). INIS.

A new method to measure the local effective charge and the local ion density in a tokamak plasma is proposed. The method is based on the measurement of the local captured fraction of a fast neutral beam injected following such an angle that the captured ions are not confined. (FR)

28670 (IPF-75-2) MEASUREMENTS OF THE FLOW RATE OF DENSE PLASMAS BY MEANS OF THE DOPPLER EFFECT. Massig, J. H. (Stuttgart Univ. (TH) (F.R. Germany). Inst. fuer Plasmaforschung). 1975. 69p. (In German). INIS.

Following a listing of different methods of the flow rate determination of flowing dense plasmas, (1) the Doppler effect measuring concept in combination with the Fabry-Perot interferometer is described, (2) the signal-noise ratio of the measuring device is dealt with, and (3) the plasma torch, the optical arrangement as well as signal detection and compensation control are described. The Ar-I line with 4,158 A was used for the flow rate measurements. The results were in good agreement with the results reported by Ahlborn (method: propagation of a decrease in luminescence). Finally, (1) three causes of errors of measurement are discussed, (2) possible methods of improving the measuring technique are presented, and (3) comparisons are made with smaller and related methods. (DE)

28671 MEASUREMENT ON A HOMOPOLAR PLASMA. Hassan, G. E. M. A.; Abbas, A. (Univ. of Riyad, Saudi Arabia). Indian J. Phys.; 49: No. 7, 499-508(Jul 1975).

A homopolar device is designed to enable rotating plasma to be investigated under dc conditions. Spectroscopic measurements with a low current dc discharge show the existence of drift velocities corresponding to rotational energies of a few hundred electron volts, for both charged and neutral particles, during operation with argon. Under operating conditions, the data of the double probes show charged particle densities of the order of 10^9 cm^{-3} and electron temperature of the order of 5 eV under the application of magnetic field. Oscillograms of probe characteristics show ion oscillations in the range 5.5 to 100 Kc/s and an ion Larmor radius of the order of 1.7 cm. The electron collision frequencies are such that $w\tau \gg 1$. Stored energy measurements by means of a Crowbar transient show rotational energies of the order of 10^{-6} joules per unit volume.

28672 DIAGNOSTIC TECHNIQUES IN LASER FUSION RESEARCH. Mallozzi, P. J.; Epstein, H. M. (Battelle Columbus Labs., OH). Res./Dev.; 27: No. 2, 30-31, 33-34, 36, 38, 40, 42(Feb 1976).

The problems of diagnosing a laser-produced plasma are described. Some measuring methods for neutrons, x radiation, charged particles, and light are discussed. The use of plastic scintillators, x-ray spectroscopy, x-ray calorimetry, and x-ray photography is mentioned along with some other diagnostic techniques. (MOW)

28673 THOMSON SCATTERING MEASUREMENTS IN A LASER HEATED THETA-PINCH. Pearlman, J. S. Seattle; Univ. of Washington (1974). 128p. University Microfilms Order No. 75-28,414.

Thesis (Ph. D.).

Measurements of the interaction of CO_2 laser radiation with a theta pinch plasma have been made using laser scattering as a diagnostic technique. Laser scattering is particularly suited for these types of measurements because the small observation volume with respect to the size of the plasma reduces problems of plasma temperature and density gradients. In addition the technique does not require the existence of local thermodynamic equi-

librium for validity. Laser scattering theory is presented including a discussion of magnetic, collisional, quantum mechanical and relativistic effects. Design and construction of the scattering experiment are described along with measurements of the ruby and CO_2 lasers. The plasma was heated axially with a TEA CO_2 pin laser. A density minimum in the core of the plasma which was observed by image converter photographs resulted in light piping of the CO_2 laser beam. The scattering measurements have shown the time evolution of the laser heated plasma during and after heating by the "spike" of the CO_2 laser. The observation of a rapid temperature rise from 20,000°K to 39,000°K followed by an increase in plasma density from 1.5×10^{15} to 2.5×10^{15} electrons/cm^3 is shown to correlate with predictions of a theoretical plasma heating model. The energies involved in the change of plasma conditions agree well with the theoretical absorption associated with the inverse bremsstrahlung mechanism. (Diss. Abstr. Int., B)

28674 THEORETICAL STUDY OF THE STRIPED COLLECTOR. Mak, S. I. Madison; Univ. of Wisconsin (1975). 141p. University Microfilms Order No. 75-18,184.

Thesis (Ph. D.).

A striped collector is a wall probe designed to measure the rate at which a plasma is lost to the containing wall. It is composed of a series of conducting stripes, separated by insulating material in between. Alternate stripes are biased together at the same potential. The collector, due to its periodic structure, possesses a self-shielding property with regard to the potential difference imposed between the stripes, thus minimizing the perturbation a large probe may produce in a plasma. The I–V characteristic measured with the collector is a plot of the current versus the potential difference between consecutive stripes. The purpose of this paper is to enable one to deduce the value of the plasma loss flux from the I–V characteristic measured with a floating striped collector, for both an unmagnetized and a strongly magnetized plasma. (Diss. Abstr. Int., B)

28675 CORRECTION FOR REFRACTIVE-RAY BENDING IN AXIALLY-SYMMETRIC PLASMA SOURCES. Popovic, S.; Konjevic, N. (Inst. of Physics, Belgrade). J. Quant. Spectrosc. Radiat. Transfer; 16: No. 1, 15-19(1976).

Numerical methods are presented for correction of end-on plasma spectroscopic measurements distorted by refractive index gradients. (auth)

28676 TEMPERATURE DETERMINATION IN AN INDUCTIVELY COUPLED rf PLASMA. Visser, K.; Hamm, F.M.; Zeeman, P.B. (Department of Physics, University of Stellenbosch, Stellenbosch 7600, Republic of South Africa). Appl. Spectrosc. 30: No. 1, 34-38 (Jan 1976).

Simultaneous relative radiances of the H_β, H_γ, and H_δ spectral lines of hydrogen were measured sequentially at various lateral positions in an inductively coupled rf argon-hydrogen plasma operated at atmospheric pressure (12 kW, 9 MHz). Measurements to take self-absorption into account were also performed. By applying an Abel integral inversion, a radial radiance profile for each line was obtained. With the two-line temperature method, simultaneous temperature profiles were obtained from each of the three line-pairs. The difference between these three sets of values and the negative values obtained for the H_γ:H_δ pair indicates that thermal equilibrium does not exist in this plasma. (auth)

28677 DETERMINATION OF PLASMA PARAMETERS OF LASER-PRODUCED ALUMINIUM PLASMA FROM X—RAY LINE RADIATION. Landshoff, R.K.; Perez, J.D. (Lockheed Palo Alto Research Laboratory, 3251 Hanover Street, Palo Alto, California 94304). Phys. Rev. A 13: No. 4, 1619-1632 (Apr 1976).

The important rates for a high-electron-density ($\gtrsim 10^{21}$ cm^{-3}) aluminium plasma containing Al^{XI-XIV} ions are presented as a function of electron temperature. The collisional excitation rates are calculated in the Coulomb-Born approximation. The effect of electron collisions upon the dielectronic recombination rates is included. The nonlinear set of statistical equilibrium equations for constant electron density and temperature plus the averaged radiation transport equations are solved to give the emitted power density in each line as a function of the angle to the normal to the face of the coin-shaped plasma. Comparison with observations from a laser-produced plasma gives a determination of the average electron density, electron temperature, and physical thickness of the plasma during the time and in the region of maximum radiation. (auth)

28678 HIGH-PRESSURE LANGMUIR PROBE IN A WEAK FLOWING PLASMA OR A PLASMA SHEATH. Smy, P.R.; Noor, A.I. (Department of Electrical Engineering, University of Alberta, Edmonton, Alberta, Canada). J. Appl. Phys. 47: No. 4, 1327-1331 (Apr 1976).

A theory is developed for the current to a negatively biased probe in a moving weakly ionized plasma or a stationary ion sheath. It is found that at low ionization densities the current is no longer space-charge limited but is, in fact, limited by the electric field generated by the probe. For a cylindrical probe the current per unit length $I=2\pi\mu n_0 eV[\log(I/n_0 e v_f r_p)-1/2]^{-1}$, where μ is the mobility of the ion, e is the electronic charge, V is the probe potential (negative), I is the probe current, v_f is the plasma flow velocity, n_0 is the plasma ionization density, and r_p is the probe radius. For a spherical probe the current $I=4\pi\mu n_0 e r_p V$. Measurements with a cylindrical probe at densities down to 10^{12}/m^3 show good agreement with theory. (auth)

28679 LINE EMISSION IN Al XI AS AN OPTICAL DIAGNOSTIC IN LASER-HEATED PLASMAS. Davis, J. (Naval Research Laboratory, Washington, D.C. 20375); Whitney, K.G. J. Appl. Phys. 47: No. 4, 1426-1435 (Apr 1976).

An extension of an earlier model of a laser-heated aluminum plasma is made to describe line emission in these plasmas from the lithiumlike Al XI ion. The model includes a satellite to the He_α-like line and the six most prominent lines originating from single excitations in Al XI. The core of the plasma is heated directly and cooled by thermal conduction losses to an equal volume of outer plasma, by a free hydrodynamic expansion, and by radiative losses principally from the hydrogen, heliumlike, and lithiumlike ionization stages. A study is made of the emission from plasmas initially at ion densities that, for a fully ionized plasma, would have critical electron densities for absorption of CO_2, neodymium, and frequency-tripled neodymium laser radiation. Curves showing the integrated emission from different lines in Al XI are presented and correlated to the different plasma densities, peak average temperatures, and conduction loss rates. (auth)

28680 PLASTIC BUBBLES AND TAMPER $\langle \rho R \rangle$ MEASUREMENTS FOR LASER-DRIVEN FUSION EXPERIMENTS. Mayer, F.J.; Rensel, W.B. (KMS Fusion, Incorporated, P. O. Box 1567, Ann Arbor, Michigan 48106). J. Appl. Phys. 47: No. 4, 1491-1495 (Apr 1976).

A new diagnostic technique is described which makes use of large-diameter (~5 cm) thin-walled (~10 μm) plastic bubbles to collect neutron-activated tamper material in a laser-driven fusion experiment. The plastic bubble and radioactive material are dissolved in a solvent and counted in a Čerenkov scheme to determine the average tamper $\langle \rho R \rangle$ at peak compression conditions. The bubble energy flow and other plasma diagnostic characteristics are also briefly discussed. (auth)

28681 DETECTION OF BRILLOUIN BACKSCATTERING IN UNDERDENSE PLASMAS. Turechek, J.J.; Chen, F.F. (Electrical Sciences and Engineering Department, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 36: No. 13, 720-724 (29 Mar 1976).

Two new results are reported: (1) verification of the finite-interaction-length threshold for stimulated Brillouin scattering in a plasma with no critical layers, and (2) use of the time-dependent Stark effect to detect ion-frequency electric fields in a plasma. (auth)

28682 SPATIALLY RESOLVED MEASUREMENTS OF PLASMA INSTABILITIES USING A HEAVY ION BEAM PROBE. Glowienka, J.C.; Jennings, W.C.; Hickok, R.L. (Electrical and Systems Engineering Department, Rensselaer Polytechnic Institute, Troy, New York 12181). Appl. Phys. Lett. 28: No. 9, 485-487 (1 May 1976).

A heavy ion beam probe has been used to obtain spatially resolved instability measurements in an energetic magnetically confined plasma. The amplitude and phase of both density and space potential fluctuations associated with a coherent 70-kHz oscillation have been measured in a hollow cathode discharge. The measurements are made simultaneously from the same point in the plasma, are continuous in time, and have a spatial resolution element of <5 mm. (auth)

28683 PHOTOGRAPHIC OBSERVATION OF THE PATH OF A LASER BEAM IN A PLASMA. Box, S.J.C.; Byszewski, W.W.; John, P.K. (Department of Physics and Center for Chemical Physics, The University of Western Ontario, London, Canada). Appl. Phys. Lett. 28: No. 9, 531-533 (1 May 1976).

The path of a CO_2 laser beam through a plasma is photographed by an image converter camera in conjunction with an interference filter. The filter was used to isolate a silicon impurity line the intensity of which was very sensitive to changes in plasma temperature produced by the absorption of the laser energy. (auth)

28684 MICROPROCESSOR SYSTEM TO RECOVER DATA FROM A SELF-SCANNING PHOTODIODE ARRAY. Koppel, L. N.; Gadd, T. J. (Univ. of California, Livermore). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 301-302(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A microprocessor-controlled digital system was developed to recover data from an x-ray spectrometry experiment which is a component of the laser-fusion program at the Lawrence Livermore Laboratory. The system software allows extensive interaction between the experimenter and the microprocessor controller. The microprocessor has proved to be well-suited for handling large

arrays of data at a low level of software sophistication, and its low cost and large memory capacity make it an attractive alternative to a minicomputer system. (auth)

28685 ELECTRON TEMPERATURE IN A MAGNETICALLY CONFINED PLASMA. Saxena, A. P.; Saxena, R. K. (Coll. of Engineering and Tech., Raipur, India). Indian J. Pure Appl. Phys.; 13: No. 9, 614-616(Sep 1975).

Electron temperature (T_e), in a weakly ionized plasma under longitudinal magnetic confinement (0-200 G), was measured with the help of sonic probe and Johnson's double probe method, using similar experimental conditions. It is observed that the value of T_e measured by sonic probe increases with increasing magnetic field, while it decreases when measured by the double probe method. The observed disparity in the results is discussed. (auth)

Plasma Kinetics (General)

Refer also to abstract 31222.

28686 (AD/A-009646) DYNAMICS OF A FOCUSED DISCHARGE. Final Scientific Report, 1 Feb 1970–31 Jan 1975. Mawardi, O. K. (Case Western Reserve Univ., Cleveland, Ohio (USA)). 31 May 1975. 56p. NTIS $4.25.

This report describes theoretical and experimental investigations on the dynamics of a dense plasma focus. The characteristics of the focus in terms of x-ray and neutron production are described. A diagnostic procedure for the analysis of the momentum of the deuterons ejected from the focus is also described. The results of a preliminary theoretical investigation of the heating of a dense plasma focus by a laser is given. (GRA)

28687 (INIS-mf-1887) WILLS PLASMA PHYSICS DEPARTMENT TWENTY-EIGHTH 6-MONTH PROGRESS REPORT 1st JULY–31st DECEMBER 1974. (Sydney Univ. (Australia). School of Physics). 1975. 8p. INIS.

Progress is reported on several research programs which include: plasma sources, hydromagnetic shock waves, rotating plasmas, icr heating and magnetoacoustic heating, carbon dioxide laser interferometer, dye lasers, and plasma-scanned Michelson interferometer. (INIS)

28688 (INIS-mf-1888, pp 123-156) RADIATION FROM A SOURCE IN A COLD MAGNETOACTIVE PLASMA, REVISITED. Application to Cyclotron and Multipole Radiation. Chapter 6. Hoyng, P.; Stevens, G. A. (Rijksuniversiteit, Utrecht). 23 Jun 1975.

This chapter will be published in Phys. Fluids; 60 refs., 5 figs.

In studies on hard x-ray emission from solar flares and on cyclotron radiation from a cold magnetoplasma. (Rijksuniversiteit Utrecht (Netherlands)).

An analysis is presented of the radiation emitted by an arbitrary source in a cold magnetoactive plasma. The plasma is supposed to be infinite and homogeneous; its dielectric properties are described by a dielectric tensor. Expressions for the radiation fields are derived using the technique of Fourier-decomposition. An expression for the vector potential is constructed and elaborated as far as possible for an arbitrary current source. The approach differs from that in previous work in that the sequence in which the various integrations are carried out has been changed. The radiation flux is defined on the basis of Poynting's vector S; in the definition, there is a distinction between current sources behaving as a given function of time and randomly fluctuating sources. In the latter case, an ensemble average is used rather than a time average. The general result for the radiation flux is then specified for cyclotron radiation from a stationary ensemble of electrons and for multipole radiation. For both types of radiation, expressions are obtained that differ from those previously given. In the case of cyclotron radiation, e.g., there is a different harmonic frequency. The cause of these differences is indicated. Throughout the paper a compact notation could be used on the basis of the work of Bremmer. (INIS)

28689 (JAERI-M-5888) ANNUAL REPORT OF THERMONUCLEAR FUSION LABORATORY. For the Period of April 1, 1973 to March 31, 1974. (Japan Atomic Energy Research Inst., Tokyo). Oct 1974. 106p. INIS.

Activities in Thermonuclear Fusion Laboratory for the period April 1973–March 1974 are described. At the end of June 1973, the JFT-1 was shut down after four years of successful operation. A preliminary experiment with a dynamic limiter and experiments with an improved diagnostic system were carried out with the JFT-2, which started operation in the preceding year. Power-up of the generator for the toroidal coil for the JFT-2 phase-II experiment was started. Construction of the JFT-2a (a tokamak of teardrop cross-section with an axisymmetric divertor) continued. Further heating of tokamak plasma with neutral beam injection, the energy loss by impurities in plasma and stability of plasma were studied theoretically. A concept of the JT-60 (a tokamak confining a plasma of nearly reactor conditions) was developed and its design was started. Design study of a fusion reactor was carried out in order to clarify the problems on fusion reactor development. (auth)

28690 (NP-20860) WILLS PLASMA PHYSICS DEPARTMENT THIRTIETH 6-MONTH PROGRESS REPORT, 1 JULY–31 DECEMBER 1975. (Sydney Univ. (Australia). School of Physics). 1975. 8p. (PR-30). Dep. NTIS (US Sales Only) $3.50.

Research is reported on the following topics; plasma sources, hydromagnetic shock waves, rotating plasmas, magnetohydrodynamics, laser diagnostics and far infrared interferometry.

28691 ANALYSIS OF ION ENERGY DISTRIBUTIONS IN THE LEVITATED TOROIDAL OCTUPOLE. Breun, R. A. Madison, WI; Univ. of Wisconsin (1975). 275p. University Microfilms Order No. 75-23,833.

Thesis (Ph. D.).

This thesis describes a discrepancy between the zeroth moment of ion distribution functions measured by the magnetic extraction–electrostatic energy analyzer method and total density measurements from a microwave Fabry-Perot interferometer. By a process of elimination, electrostatic effects at the entrance aperture of the extractor were found to be the cause. A model was formulated that describes some of the major features of this effect. Experimentally, this discrepancy did not involve major energy dependent distortions in the distribution function for ion energies above four electron volts. (Diss. Abstr. Int., B)

28692 STIMULATED SCATTERING OF LASER RADIATION IN A PLASMA. Burunov, E. A.; Malyshev, G. M.; Razdobarin, G. T.; Semenov, V. V.; Folomkin, I. P. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 68: No. 1, 111-114(1975). (In Russian).

In experiments on the scattering of laser radiation in a plasma, there has been revealed a significant increase in the power of the scattered radiation for the ion component of the spectrum in comparison to the level corresponding to scattering due to thermal fluctuations. The increase of the scattering signal was observed with fulfillment of the threshold condition for the excitation of parametric instability in plasma under the action of electromagnetic radiation. (JPRS)

28693 MEASUREMENT OF THE ABSORPTION COEFFICIENT FOR THE He–Ne LASER RADIATION IN A PURE HYDROGEN PLASMA. Oeke, G. (Ankara Univ. (Turkey). Dept. of Physics). Appl. Phys.; 8: No. 2, 173-177(Oct 1975).

The absorption coefficients for 6,328 A and 1.15 μm radiations in a pure hydrogen plasma were measured and compared with the corresponding calculated values. The absorption coefficients of these radiations were found to be in agreement with the sum of the theoretically calculated absorptions due to photoionization of the neutral atoms and the inverse-bremsstrahlung in the field of ions. (DE)

28694 PLASMA FOCUS AND THERMONUCLEAR SYNTHESIS. Maisonnier, C. Zh. Prikl. Mekh. Tekh. Fiz.; No. 4, 23-32(1975). (In Russian).

The article presents present-day ideas of phenomena taking place in a plasma focus, analyzes the efficiency of various channels for energy transfer in a plasma focus, and reviews a number of ideas dealing with extrapolation to larger-scale equipment. (SJR)

28695 MODEL CALCULATIONS ON THE POSITIVE COLUMN OF A MEDIUM PRESSURE NEON GAS-DISCHARGE. Smits, R. M. M.; Lammers, P. H. M.; Baghuis, L. C. J.; Hagedoorn, H. L.; van der Heide, J. A. (Eindhoven Univ. of Technology (Netherlands). Cyclotron Lab.). Beitr. Plasmaphys.; 14: No. 5, 157-168(1974).

Model calculations on the positive column of a neon gas-discharge for gas pressures between 50 and 350 torr and currents between 5 and 100 mA are presented. In these calculations a Druyvesteyn distribution for the electron energy has been used. Volume recombination and radially dependent electron and gas temperatures have been taken into account. Numerical results are compared with available experimental data. In particular, the axial field strength, electron density, electron temperature and ambipolar field strength are considered. In general, the agreement between experimental and numerical data is good.

28696 ZAKLADY KLASICKE A KVANTOVE FYZIKY PLASMATU. (Principles of Classical and Quantum Plasma Physics).

Kracik, J.; Sestak, B.; Aubrecht, L. Prague; Academia (1974). 320p. (In Czech)

14 figs.; official textbook for colleges and universities in Czechoslovakia.

Basic principles of classical and quantum plasma physics are summarized. The following topics are dealt with: statistical mechanics of charged particles (kinetic equations), mutual interaction of particles, the Boltzmann equation, general methods of solving the Boltzmann equation, expansion of the Boltzmann equation to the series and to the tensor form, Coulomb interactions and the Fokker-Planck equation, principles of quantum statistical physics, application of quantum kinetic equations. (ZS)

28697 MERCURY TRANSITION COEFFICIENTS IN A PLASMA. Influence of the Distribution Function. Damelincourt, J. J.; Dimitriadis, A. (Toulouse-3 Univ., 31 (France). Centre de Physique Atomique et Nucleaire); Scoarnec, L. (Centre Technique de la Compagnie des Lampes, 92-Puteaux (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 1, 21-24(7 Jul 1975). (In French)

The influence of the experimental conditions on the transition coefficients in argon-mercury discharges is studied. The results obtained show that it is more convenient to describe these discharges by taking into account a reduction in the number of high energy electrons. (FR)

28698 IMPORTANCE OF THE DEPENDENCE OF THE SECONDARY ELECTRON EMISSION COEFFICIENT ON E/p_0 FOR PASCHEN BREAKDOWN CURVES IN AC PLASMA PANELS. Sahni, O.; Lanza, C. (IBM Thomas J. Wastson Research Center, Yorktown Heights, New york 10598). J. Appl. Phys. 47: No. 4, 1337-1340 (Apr 1976).

Apparent deviations from Paschen's law, observed in ac plasma panels, have been resolved by generalizing the breakdown criterion to include the dependence of the secondary electron emission coefficient on E/p_0. Incorporation of this dependence into the proposed effective coefficient involves consideration of both the back-diffusion phenomenon and the influence of E/p_0 on the efficiency of metastable atom generation. Calculated voltage breakdown curves in pure neon and neon plus 0.1% argon mixture are in good agreement with experimental data for both the metal electrode dc discharges and the insulator-covered electrode discharges found in ac plasma panels. (auth)

Plasma Kinetics (Experimental)

Refer also to abstracts 30721 and 31150.

28699 ESTIMATION OF TEMPERATURE OF PLASMA FLOW USING A THERMOCOUPLE. Kanzawa, A. (Tokyo Inst of Technol, Jpn). Heat Transfer - Jpn. Res.; 3: No. 3, 15-18(Jul-Sep 1974).

The temperature distributions of plasma flow, in which velocity distributions are known, were estimated using the heat input rates to the spherical junction of the thermocouple, and it was noticed that these results agree fairly well with those obtained by spectroscopic methods.

28700 ION DISTRIBUTION IN A STRAIGHT DISCHARGE. Fedyakov, V.P. (D. V. Efremov Scientific Research Institute of Electrophysical Apparatus, Leningrad). Sov. Phys.-Tech. Phys. 20: No. 8, 1085-1088 (Aug 1975).

An electrostatic analyzer is used to study the ion distribution in straight hydrogen discharge. Two groups of ions, with $A/Z=1$ and 16, are distinguished on the basis of the transit time. The energy distribution consists of several groups of protons with various partial densities and temperatures. The ion temperature is comparable to the electron temperature: $T_e/T_i \sim 1 \div 8$. There is a fine structure in the ion distribution, consisting of perturbations which are periodic in the velocity, i.e., which appear at intervals $\Delta v \simeq$const. The functions $u_i/\Delta v\alpha = v_i/v_i$ and $H_q^2/8\pi nT_i \sim af(H)$ are found, where u_i is the ion thermal velocity. (auth)

Plasma Kinetics (Theoretical)

Refer also to abstracts 28732 and 28788.

28701 (AD-912678) TOKAMAK EQUILIBRIUM. Yoshii, A.; Wakatani, M.; Amano, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1973. 49p.

Two problems on tokamak equilibrium are considered. One problem concerns the maintenance of the toroidal equilibrium by means of the field due to external currents. The other problem concerns the toroidal equilibrium of a high pressure tokamak plasma with β_θ (poloidal beta). An expansion in fractional power of the inverse aspect ratio ϵ is adopted. The ordering β_θ similar to ϵ to the (K^{-1}) power is taken where $0 < K < 1$, and it is shown that the equilibrium can be solved consistently to any order in ϵ by appropriately choosing the coordinates. The case $K = \frac{1}{3}$ β_θ similar to ϵ to the $(\frac{3}{2})$ power is specifically treated, and the calculation up to the order ϵ to the 3k power (ϵ) is made, thereby including the contributions from ellipticity and triangularity of the magnetic surfaces. The shape of the conducting shell is weakly deformed from a circle to study the effects of non-circularity of the shell. (auth)

28702 REVIEW OF NEOCLASSICAL TRANSPORT THEORY. Hazeltine, R. D. (Univ. of Texas, Austin). pp 273-309 of Advances in Plasma Physics. Vol. 6. Kaw, P. K. New York; John Wiley and Sons, Inc. (1976).

The neoclassical theory is reviewed from three complementary points of view: (1) the moment equations, (2) the guiding center motion, and (3) the distribution function. A summary is given of the results and their relation to experiments. (MOW)

28703 NEOCLASSICAL THEORY OF DIFFUSION. Galeev, A. A.; Sagdeev, R. Z. (Inst. of High Temperature, Moscow). pp 311-420 of Advances in Plasma Physics. Vol. 6. Kaw, P. K. New York; John Wiley and Sons, Inc. (1976).

Transport processes in very simple models of traps in tokamaks, levitrons, and stellarators were reviewed. A summary of research on transport coefficients of a rarefied plasma is given. (MOW)

28704 GUIDING-CENTER PLASMAS AND INVISCID NAVIER-STOKES FLUIDS IN TWO DIMENSIONS. Seyler, C. E. Jr. Iowa City, IA; Univ. of Iowa (1975). 143p. University Microfilms Order No. 76-2176.

Thesis (Ph. D.).

The equilibrium properties of a two-dimensional plasma are examined theoretically within the framework of the random phase approximation. Using a judicious treatment of periodic boundary conditions, extensive thermodynamic functions are found. When restricted to the guiding-center plasma, the results predict a new negative temperature threshold energy and give an explicit analytical form for the structure function. When these results are compared to the predictions of a Monte Carlo method, good agreement is found with respect to both threshold energy and structure function form. A thermal equilibrium energy spectrum is also found which is formally similar to the continuum result and which agrees at least qualitatively with particle-in-cell simulations of guiding-center plasmas. A numerical test is provided for the Kraichnan two-temperature probability distribution for a two-dimensional inviscid Navier-Stokes fluid in turbulent equilibrium. By numerically integrating the truncated Fourier space Navier-Stokes equation one finds the spectral densities for stationary turbulence for a variety of initial conditions. (Diss. Abstr. Int., B)

28705 VLASOV SIMULATION IN CONFIGURATION SPACE AND ORDINARY ELECTROMAGNETIC MODE INSTABILITY. Cheng, C. Z. Iowa City, IA; Univ. of Iowa (1975). 174p. University Microfilms Order No. 76-2103.

Thesis (Ph. D.).

A convenient, fast, and accurate method of solving the one-dimensional Vlasov equation numerically in configuration space is described. It treats the convective terms in the x and v directions separately and produces a scheme of second order in DELTA t. The resulting free-streaming and accelerating equations are computed with Fourier interpolation and spline interpolation methods respectively. The numerical method is tested by linear and nonlinear problems and turns out to be of high accuracy and efficiency. A new method of smoothing the distribution function is given. It reduces the computational effort by artificially increasing the entropy of the system. As a result the distribution function is smooth enough to be well represented on a given mesh. The generalized methods described deal with more complicated cases such as problems with nonperiodic spatial boundary conditions, two- and three-dimensional problems with and without external magnetic and/or electric fields. The instability of the ordinary electromagnetic mode, propagating perpendicular to an external magnetic field is studied, for a single-species plasma with ring velocity distribution. The marginal instability boundaries for both the purely growing mode and the propagating growing modes are calculated from the instability criteria. The dispersion characteristics for various sets of plasma parameters are also given. In general, the unstable propagating waves are found to be centered at half harmonics (omega approximately equal to (n + ½) omega/sub c/, n equals 1,2,---). The typical growth rates are of the order of the cyclotron frequency and enhanced by increasing beta/sub parallel/. (Diss. Abstr. Int., B). Int., B)

28706 TWO-DIMENSIONAL MODEL OF A FREELY EXPANDING PLASMA. Khalid, Q. Raleigh, NC; North Carolina

State Univ. (1975). 73p. University Microfilms Order No. 76-2436.

Thesis (Ph. D.).

The free expansion of an initially confined plasma is studied by the computer experiment technique. The research is an extension to two dimensions of earlier work on the free expansion of a collisionless plasma in one dimension. In the two-dimensional rod model, developed in this research, the plasma particles, electrons and ions are modeled as infinitely long line charges or rods. The line charges move freely in two dimensions normal to their parallel axes, subject only to a self-consistent electric field. Two approximations, the grid approximation and the periodic boundary condition are made in order to reduce the computation time. In the grid approximation, the space occupied by the plasma at a given time is divided into boxes. The particles are subject to an average electric field calculated for that box assuming that the total charge within each box is located at the center of the box. However, the motion of each particle is exactly followed. The periodic boundary condition allows us to consider only one-fourth of the total number of particles of the plasma, representing the remaining three-fourths of the particles as symmetrically placed images of those whose positions are calculated. This approximation follows from the expected azimuthal symmetry of the plasma. The dynamics of the expansion are analyzed in terms of average ion and electron positions, average velocities, oscillation frequencies and relative distribution of energy between thermal, flow and electric field energies. Comparison is made with previous calculations of one-dimensional models which employed plane, spherical or cylindrical sheets as charged particles. In order to analyze the effect of the grid approximation, the model is solved for two different grid sizes and for each grid size the plasma dynamics is determined. For the initial phase of expansion, the agreement for the two grid sizes is found to be good. (Diss. Abstr. Int., B)

28707 GRID EFFECTS ON THE PLASMA SIMULATION BY THE FINITE-SIZED PARTICLE. Abe, H.; Miyamoto, J.; Itatani, R. (Kyoto Univ.). J. Comput. Phys.; 19: No. 2, 134-149(Oct 1975).

About the so-called usual models, in which the total momentum is conserved, it is well known that the total energy is not conserved due to the nonuniformity of space caused by spatial grids. It fluctuates and increases in time from a stochastic origin. In order to see the accuracy of the plasma simulations, it is important to evaluate the fluctuation K/sub g/, which is more dominant for small errors during the shorter time. A study was made of its standard deviation in t, sigma[K/sub g/], and the correlation time of dK/sub g//K · dt, tau/sub c/, about periodic one-dimensional systems, where K is the kinetic energy.

28708 ELECTRODYNAMICS OF PLASMA. Akhiezer, A. I.; Akhiezer, I. A.; Polovin, R. V.; Sitenko, A. G.; Stepanov, K. N. Moscow; Izdatel'stvo Nauka (1974). 719p. (In Russian).

This book is devoted to the theory of collective electromagnetic oscillations of a uniform plasma. The theory of hf and lf oscillations of plasma are discussed from a single viewpoint, and the basic theoretical applications of this theory are given. Oscillations of small and finite amplitude are examined. General methods are discussed for describing the plasma. Lf magnetohydrodynamic waves and magnetohydrodynamic discontinuities are examined and the theory of evolution of magnetohydrodynamic shock waves is discussed. Hf oscillations are studied both in the absence and in the presence of an external magnetic field, and equilibrium and nonequilibrium plasma are examined. A discussion is given of the theory of different types of instabilities of nonequilibrium uniform plasma, and general criteria are given for plasma instability. Detailed investigations are made of nonlinear waves in noncollision plasma and a discussion is given of the quasilinear theory of plasma and the theory of plasma turbulence. A large part of the book is devoted to the theory of fluctuations and the processes of scattering and transformation of waves and scattering of particles in plasma which are associated with them. (Ref. Zh.)

28709 ELECTROMAGNETIC FIELD BEHIND THE IONIZATION FRONT MOVING WITH THE VELOCITY OF LIGHT IN THE INHOMOGENEOUS MEDIUM. Manankova, A. V.; Borisov, V. V. (Leningrad State Univ.). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 2, 189-199(1975). (In Russian).

The solution of the problem is constructed for the conducting medium and collisionless plasma. The peculiarities of the electromagnetic field in the inhomogeneous medium, as well as the transition to a sharp boundary, are discussed. (auth)

28710 TENSOR TRANSFORMATION TECHNIQUE FOR THE TRANSPORT EQUATION. Grainick, S. L. (Plasma Physics Lab., Princeton, NJ). Nucl. Sci. Eng.; 59: No. 4, 311-318(Apr 1976).

A step-wise tensor transformation technique is presented for the transformation of the single energy group transport equation to an arbitrary spatial coordinate system. Both gradient and divergence forms of the equation are given, and the same method is applied to the derivation of the diffusion approximation. We demonstrate that using an orthogonal representation of the propagation vector will simplify the divergence form of the equation. The application of this technique is in the representation of the transport equation in coordinate systems other than the usual rectangular, cylindrical, and spherical ones. Its use is demonstrated by transforming the transport equation to a toroidal coordinate system consisting of nested circular toroids.

28711 NONLINEAR PLASMA THEORY: THIRD ORDER OHM LAW IN FIELD INTENSITIES AND NONLINEAR AMPLITUDE EQUATIONS. Weil, J. W. (International Atomic Energy Agency, Vienna). Acta Phys. Acad. Sci. Hung.; 38: No. 4, 321-335(1975). (In German).

The usual nonlinear plasma theory is limited to an electrical current of the form $j = j^1 + j^2$, where j^1 and j^2 contain linear and quadratic terms in the field intensities of the waves occurring. That part of the total current which contains third-order field intensities is considered. Differential equations were derived for the longitudinal and transverse amplitude components. They have in their right-hand side interaction terms for four plasma waves. (tr-auth)

28712 TEMPERATURE DEPENDENCE OF THE ELECTRICAL CONDUCTIVITY AND RADIATION IN A PULSED HIGH-PRESSURE DISCHARGE. Rovinskii, R.E. Sov. Phys.—Tech. Phys. 20: No. 8, 1134-1135 (Aug 1975).

The analytic temperature dependence of the electrical conductivity found previously for a non-Debye plasma in a pulsed discharge is refined on the basis of a generalization of experimental data. A semiempirical relation is proposed giving the integral emission of an inert-gas plasma as a function of the pressure and temperature. The two functions are used to refine the analytic relation between the discharge temperature and the current density. (auth)

28713 REACTION RATES IN A RELATIVISTIC PLASMA. Weaver, T.A. (University of California Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. A 13: No. 4, 1563-1569 (Apr 1976).

A general theory of two-body reaction rates in a relativistic plasma is developed. The most notable results of this theory are exact expressions for total rates involving only a single integral over the cross section for the usual case of relativistic Maxwell-Boltzmann or Bose-Einstein momentum distributions. This simplification arises from the fact that in the relativistic as well as the nonrelativistic case, an effective combined-particle distribution function can be found analytically. These results are applied to calculate the rates for radiative Compton scattering, photon-photon pair creation, and pion production in proton-proton collisions. (auth)

28714 COMMENT ON THE THERMODYNAMICS OF A CLASSICAL ONE-COMPONENT PLASMA. Stroud, D. (Department of Physics, The Ohio State University, Columbus, Ohio 43210); Ashcroft, N.W. Phys. Rev. A 13: No. 4, 1660-1663 (Apr 1976).

A variational method used recently in the theory of liquid metals and screened Coulomb systems is extended to treat the thermodynamic properties of a classical, uniform, one-component plasma. The Helmholtz free energy and corresponding thermodynamic derivatives can all be expressed in concise parametric form as functions of an equivalent hard-sphere packing function. The results are generally found to agree well with recent Monte Carlo calculations, especially at temperatures close to the observed crystallization temperature. (auth)

28715 THEORY OF ELECTRIC FIELD CORRELATIONS IN A TWO-DIMENSIONAL DRIFT PLASMA. Weinstock, J. (Aeronomy Laboratory, National Oceanic and Atmospheric Administration, Boulder, Colorado 80302). Phys. Fluids 19: No. 4, 531-535 (Apr 1976).

Recently, the results of numerical simulations of electric field correlations in a two-dimensional drift plasma by Okuda *et al.* were compared with theories of strong turbulence. Discrepancies were claimed to exist. Here, a brief re-examination is made of both theories and simulations. It is found that the "observed" time dependence of the correlation is explained by theory if the short time, inertial motion, of the particles is accounted for. This inertial motion also goes a long way toward explaining the strong magnetic field dependence of the "observed" e-folding time. It is pointed out that the parameters of the simulations only marginally satisfy a basic validity condition of the theories, and that close agreement would require a more elaborate theory, than is presently available, in which higher order cumulants of the particle orbits are calculated. (auth)

28716 ANALYSIS OF PLANE THERMAL WAVES TAKING INTO CONSIDERATION THE ANGULAR VELOCITY DISTRIBUTION OF HOT ELECTRONS. Gacek, A.; Kaliski, S.; Sarzynski,

A. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 23: No. 11, 933-939(1975).

The simplified equations of electron thermal conductivity with participation of angular velocity distribution of hot electrons (HE) is considered and their solution is exemplified. Due to occurrence of two shaped wave fronts of temperatures the averaged equations, in virtue of the modified method of momentums, were constructed. By application of the perturbation method one can obtain the solution of the problem for a plane wave concerning the one-temperature plasma.

28717 CONCENTRIC THERMAL WAVES IN PLASMA WITH HOT ELECTRONS. Gacek, A.; Kaliski, S.; Sarzynski, A. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 23: No. 11, 941-947(1975).

Simplified equations of electron-type heat conduction are given in the spherical case, taking into consideration hot electrons with hemispherical distribution. The equations derived for two- and one-temperature plasma show distinctly, despite the preheating effect, two wave fronts, which permits to make averaged description. By contrast with plane cases with anisotropic distribution a considerable proportion of the energy of the laser radiation absorbed is stored in plasma under conditions of hemispherical distribution, in the form of kinetic energy of hot electrons.

Plasma Production

Refer also to abstract 31152.

28718 (MATT-Trans-114) STUDY OF FUNCTIONING AND APPLICATIONS OF A HYDROCYANIC ACID LASER. Lesieur, J. P. (Paris-11 Univ., 91–Orsay (France)). Jun 1975. Translation of Thesis. 77p. Dep. NTIS $5.45.

A study is presented of the functioning of the HCN laser, with a view to using it for interferometric measurements in the tokamak machine, now under construction at Fontenay-aux-Roses. (MOW)

28719 OBSERVATIONS OF PLASMA PRODUCTION AND DENSITY FLUCTUATIONS DURING AN OHMIC DISCHARGE IN A TOROIDAL QUADRUPOLE. Schmidt, G. L. Madison, WI; Univ. of Wisconsin (1975). 180p. University Microfilms Order No. 75-23,871.

Thesis (Ph. D.).

A study of plasma production and induced density fluctuations observed during ohmic discharges in a small, inductively driven, supported toroidal quadrupole is presented. Either or both the main poloidal and toroidal magnetic fields could be used to produce the discharge. Calculations of an average induced parallel electric field, (E/sub parallel/), are discussed. Formation of the plasma spacial profile is studied. Mechanisms which could be responsible for the fluctuations are considered. Langmuir probes were the primary plasma diagnostic employed. (Diss. Abstr. Int., B)

28720 DENSITY CAVITONS AND X-RAY FILAMENTATION IN CO_2-LASER-PRODUCED PLASMAS. Donaldson, T.P.; Spalding, I.J. (Euratom/United Kingdom Atomic Energy Authority Fusion Association, Culham Laboratory, Abingdon, Oxon, OX14 3DB, United Kingdom). Phys. Rev. Lett. 36: No. 9, 467-470 (1 Mar 1976).

Measurements of electron density and x-ray emission have been made on a C VII plasma, generated by a 9×10^{12}-W-cm^{-2} CO_2 laser beam. A density cavity and x-ray filamentation are observed. The relevance of these results to theories of resonance absorption, soliton formation, self-modulation, and filamentation of laser light is noted. (auth)

28721 NUCLEAR SYNTHESIS IN MICROPARTICLES, WHICH IS INDUCED BY AN ELECTRON BEAM. Yonas, G. (Sandia Labs., Albuquerque, NM). Zh. Prikl. Mekh. Tekh. Fiz.; No. 4, 11-22(1975). (In Russian).

Recently relativistic electron beams have found wide use in studies of nuclear synthesis. These beams are used for heating a plasma confined by a magnetic field, for pumping high-pressure gas lasers, and also as powerful energy sources for compressing and heating thermonuclear fuel. In recent years Sandia Laboratories has been studying a number of these subjects. This paper discusses recent experimental and theoretical studies on the compression of microparticles by electron beams. (SJR)

28722 LOCALIZATION OF X RAYS PRODUCED BY INTERACTION OF A RELATIVISTIC BEAM WITH A DENSE PLASMA. Kiselev, V.A.; Berezin, A.K.; Fainberg, Y.B. (Physico-technical Institute, Ukrainian Academy of Sciences). JETP Lett. 22: No. 8, 195-196 (20 Oct 1975).

It is shown that when a relativistic electron beam (current 1 A) interacts with a dense plasma ($n_e\sim10^{16}$–5×10^{16} cm^{-3}), a localization of x rays of energy ~15 keV is produced in the plasma formation region. The geometric dimensions of the localization do not exceed the geometric dimensions of the plasma formation and decrease with increasing plasma density. The intensity of the x rays is found to depend on the width of the energy spectrum of the beam electrons, on the beam current, and on the plasma density. (auth)

28723 X—RAY SPECTRUM OF A LASER-PRODUCED IRON PLASMA. Chase, L.F.; Jordan, W.C.; Perez, J.D. (Lockheed Palo Alto Research Laboratory, 3251 Hanover Street, Palo Alto, California 94304); Johnston, R.R. Phys. Rev. A 13: No. 4, 1497-1506 (Apr 1976).

We present the analysis of the x-ray spectrum between 9.5 and 17.0 Å of a laser-produced iron plasma. Wavelengths and relative intensities for 96 lines are measured. For the strongest part of the spectrum, above 13 Å, almost all of the observed lines are identified as radiation from Fe^{XVII}, Fe^{XVIII}, and Fe^{XIX} ions. Measurements were made with a curved-crystal spectrograph. Calculations were full intermediate coupling, Hartree-Fock with relativistic corrections. Coulomb-approximation oscillator strengths were used to help in the line identification. (auth)

28724 SPACE-RESOLVED SPECTRA OF LASER-PRODUCED PLASMAS IN THE XUV. Feldman, U.; Doschek, G.A.; Prinz, D.K. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D.C. 20375); Nagel, D.J. J. Appl. Phys. 47: No. 4, 1341-1350 (Apr 1976).

Monochromatic images of laser-produced plasmas have been obtained in the 200–550-Å region using a slitless normal-incidence spectrograph. The plasmas were produced by subnanosecond 10^{16} W cm^{-2} irradiation of thick and thin targets containing a wide variety of elements. The XUV emission is observed to extend several millimeters from the target surface. Secondary regions of emission were frequently observed 2–3 mm from the target. The regions of plasma emission usually lie along the direction of the incident laser pulse. The ions present in the spectra are formed at electron temperatures that range from $\sim7\times10^5$ to $\sim7\times10^6$ K. Density-sensitive spectral line ratios are used to show that the plasma electron density decreases by no more than an order of magnitude over a few millimeters. Similar spectra were observed on both sides of 7-μm Fe foil irradiated with a 100-psec pulse, implying a penetration velocity on the order of 10^7 cm sec^{-1}. It was deduced from spectra of thin foils that the penetration of the laser pulse used is about 10 μm of iron. A technique is proposed for obtaining time- and space-resolved spectra over time intervals of a few tens of picoseconds. The imaging properties of the slitless spectrograph and a method of improving the spatial resolution of the instrument are discussed in the Appendix. (auth)

28725 DENSE-PLASMA PRODUCTION BY A LIQUID-CATHODE ARC. Thiell, G.; Rosseler, A.; Fabry, M. (Laboratoire de Physique des Milieux Ionisés, Université de Nancy I, 54037 Nancy Cedex, France). J. Appl. Phys. 47: No. 4, 1724-1725 (Apr 1976).

We describe an experimental apparatus allowing the study of a dense arc plasma generated between a solid anode and a liquid-potassium cathode. (auth)

28726 DISTRIBUTION OF SELF-GENERATED CURRENT IN LASER-PRODUCED PLASMAS. Drouet, M.G.; Bolton, R. (Direction Sciences de Base, Institut de Recherche de l'Hydro-Québec, Varennes, Québec, Canada, JOL 2PO). Phys. Rev. Lett. 36: No. 11, 591-594 (15 Mar 1976).

The current associated with the self-generated magnetic field has been measured in air and nitrogen at various pressures in a 4-J, 30-nsec-Nd laser-produced plasma using a fast probe embedded in the copper target. The results reveal an active participation of the target in the current-flow process with anodic and cathodic regions, the source of the current (magnetic field) being at the plasma-target interface. (auth)

28727 LASER LIGHT ABSORPTION MEASUREMENTS IN AN INTERACTION-PRODUCED PLASMA COLUMN. Pincosy, P.A.; Bournot, P.; Dufresne, D.; Caressa, J.P.; Autric, M. (Institut de Mécanique des Fluides, Marseille, France). Appl. Phys. Lett. 28: No. 10, 583-585 (15 May 1976).

100 J of 10.6-μ laser energy produced in a 1.5-μs pulse was focused to a 2-mm-diam spot by a 50-cm-focal-length mirror. A plasma was created by breakdown in the 70-ns gain-switched peak of the pulse where the light flux becomes greater than 10^{10} W/cm^2. The plasma column subsequently created in 5–20 Torr of hydrogen by the absorbed light energy was observed by 5-ns exposure and streak photographs. The aspect of beam trapping is demonstrated by measurements of the transmitted light intensity radial distribution and significant energy absorption is shown by the measurement of transmitted energy. (auth)

Plasma Stability

Refer also to abstracts 28655 and 30987.

28728 (AD/A-006744) CORRELATION ANALYSIS OF TURBULENT PLASMAS. Final Report, 1 Apr 1972-30 Sep 1973. Shaw, D. T. (State Univ. of New York, Buffalo (USA). Dept. of

Engineering Science). 1974. Contract N00014-72-C-0412. 35p. NTIS $3.75.

The objective of the program is to develop a method for the measurement of the correlation functions which in turn are used for the investigation of the nature of the instabilities and their role in the turbulent diffusion in the plasma. Special emphasis is placed on the testing of a diagnostic technique which is simple and sensitive enough for the relatively small-volume and low-density plasma source used in the program. In the present report, the cross-beam correlation technique is first discussed. This is followed by a section on the use of the laser-interferometric method for determination of electron density. In the last section, the important findings and recommendations are discussed. (GRA)

28729 (MATT-1229) NUMERICAL STUDY OF THE MHD SPECTRUM IN TOKAMAKS WITH A NONCIRCULAR CROSS SECTION. Kerner, W. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Mar 1976. 43p. Dep. NTIS $4.00.

The behavior of a class of exact tokamak equilibria is investigated in the context of ideal magnetohydrodynamics. The equilibrium solution allows for a general plasma cross section shape, restricted to systems with essentially flat toroidal current profiles. The spectrum of the eigenmodes is evaluated by extremizing the Lagrangian using a Galerkin procedure. The different branches of the spectrum are appropriately represented by expanding the eigenfunctions in terms of the eigenfunctions of the corresponding straight limit. The perturbed vacuum field is expressed by a vector potential. The code is applied to various configurations with a fixed and with a free plasma boundary. The influence of ellipticity of the cross section and of the aspect ratio on the spectrum is discussed.

28730 ION CYCLOTRON INSTABILITIES IN FINITE BETA MIRROR PLASMAS. Uckan, T. Ann Arbor, MI; Univ. of Michigan (1975). 261p. University Microfilms Order No. 75-29,338.

Thesis (Ph. D.).

A general dispersion relation for arbitrary propagation of electrostatic and electromagnetic waves in an infinite, collisionless, weakly inhomogeneous, anisotropic high beta plasma is derived. By taking into consideration the coupling between longitudinal and transverse waves the appropriate dispersion relations for the ion cyclotron instabilities with k/sub perpendicular/ much greater than k/sub z/ and T/sub i/ much greater than T/sub c/ are deduced and applied to mirror-confined plasmas. A real k stability analysis has been carried out analytically for the flute-like (k/sub z/ not equal to 0) drift-cone and loss-cone modes for various values of beta and electron temperature as well as other plasma parameters. Flute-like (k/sub z/ equals 0) drift-cyclotron and mirror ratio-dependent drift-cone modes were also examined for high beta effects.

28731 PARAMETRIC EXCITATION OF PLASMA INSTABILITIES WITH A DENSITY MODULATED RELATIVISTIC ELECTRON BEAM. Basu, B. New York; Columbia Univ. (1975). 113p. University Microfilms Order No. 75-18,355.

Thesis (Ph. D.).

Parametric electrostatic instabilities in a non-relativistic, stationary plasma excited by a monoenergetic, relativistic electron beam with density sinusoidally modulated along the direction of the beam flow have been theoretically investigated using multiple-time-scale perturbation expansion method. The linear growth rate and the width of the spectrum of parametrically excited unstable beam-synchronous and high frequency electron plasma oscillation modes have been determined. It has been found that, for a given beam to plasma density ratio, there exists an upper limit to the initial beam kinetic energy for which the instabilities can be excited. Within the allowed range, maximum growth rate exhibits a minimum as the beam energy increases from its non-relativistic value. This relativistic feature has to be contrasted with the two-stream instability case where maximum growth rate falls off monotonically with the increasing energy. In the non-relativistic limit, maximum growth rate as well as the width are found to be about two orders of magnitude larger than those obtained by a previous author. (Diss. Abstr. Int., B)

28732 ADVANCES IN PLASMA PHYSICS. Volume 6. Kaw, P. K.; Kruer, W. L.; Liu, C. S.; Nishikawa, K. New York; John Wiley and Sons, Inc. (1976). 606p.

Separate abstracts were prepared for the 9 included papers. (MOW)

For abstracts of individual papers see: 28702, 28703, 28733–28737, 28787, and 28788.

28733 GENERAL FORMALISM OF PARAMETRIC EXCITATION. Nishikawa, K. (Hiroshima Univ.); Liu, C. S. pp 3-81 of Advances in Plasma Physics. Vol. 6. Kaw, P. K. New York; John Wiley and Sons, Inc. (1976).

A modal analysis of parametric instabilities in plasma is given. The effects of geometry on decay instabilities are discussed along with certain nonlinear aspects of parametric processes. (MOW)

28734 PARAMETRIC INSTABILITIES IN HOMOGENEOUS UNMAGNETIZED PLASMAS. Liu, C. S. (Univ. of Maryland, College Park); Kaw, P. K. pp 83-119 of Advances in Plasma Physics. Vol. 6. Kaw, P. K. New York; John Wiley and Sons, Inc. (1976).

The following topics are included: (1) general formalism of parametric processes in a plasma, (2) parametric instability of the pump wave with frequency near the plasma wave: omega$_0$ x omega /sub p/, (3) Raman scattering of electromagnetic waves in plasmas, (4) scattering of ion modes; Brillouin scattering; and modational instabilities, and (5) decay of the pump wave into two plasmons. (MOW)

28735 PARAMETRIC INSTABILITIES IN AN INHOMOGENEOUS UNMAGNETIZED PLASMA. Liu, C. S. (Univ. of Maryland, College Park). pp 121-177 of Advances in Plasma Physics. Vol. 6. Kaw, P. K. New York; John Wiley and Sons, Inc. (1976).

An electromagnetic wave normally incident to a nonuniform plasma slab with increasing density is theoretically considered. An analysis for Raman and Brillouin scattering is given. A theoretical description of parametric instabilities in an inhomogeneous plasma near the point of critical density is presented. (MOW)

28736 PARAMETRIC EXCITATION OF ELECTROSTATIC WAVES IN A MAGNETIZED PLASMA. Kaw, P. K. (Physical Research Lab., Ahmedabad, India). pp 179-206 of Advances in Plasma Physics. Vol. 6. Kaw, P. K. New York; John Wiley and Sons, Inc. (1976).

A comprehensive discussion of parametric excitation of electrostatic waves in magnetized plasma is given. A general derivation of the dispersion relation is presented. The dispersion relation is analyzed for two cases, that is (a) when the driving frequency is near the resonant frequency of electron modes, and (b) when the driving frequency is near the lower hybrid frequency. Some general remarks and a brief comparison of theory with experiment and computer simulations are given. (MOW)

28737 SATURATION AND NONLINEAR EFFECTS OF PARAMETRIC INSTABILITY. Kruer, W. L. (Univ. of California, Livermore). pp 237-269 of Advances in Plasma Physics. Vol. 6. Kaw, P. K. New York; John Wiley and Sons, Inc. (1976).

A brief discussion of previous studies on parametric instabilities is given in order to illustrate the characteristic nonlinear effects. The discussion covers both theory and computer simulation. (MOW)

28738 FEEDBACK STABILIZATION EXPERIMENT ON A SCREW PINCH. Keller, R.; Pochelon, A.; Bachmann, W. (Centre de Recherches en Physique des Plasmas, Ecole Polytechnique Fédérale de Lausanne, CH-1007 Lausanne, Switzerland). Phys. Rev. Lett. 36: No. 9, 465-467 (1 Mar 1976).

Suppression of the $m=1$ growing mode of a screw pinch is obtained by feedback stabilization. The transverse field produced by $l=1$ windings is automatically controlled by the magnetically detected plasma motion, in order to create a restoring force for both displacement coordinates. (auth)

28739 SIMULATION OF DISSIPATIVE TRAPPED-ELECTRON INSTABILITY IN LINEAR GEOMETRY. Matsuda, Y.; Okuda, H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 36: No. 9, 474-478 (1 Mar 1976).

A simulation model has been developed to study the low-frequency trapped-particle instability in a linear geometry. Low-frequency drift instabilities identified as the dissipative trapped-electron modes grow, accompanied by the turbulent transport of plasma. Measured electron heat conductivity is a few times larger than the particle diffusion constant. (auth)

28740 MUTUAL TRANSFORMATION OF TRANSVERSE AND LONGITUDINAL WAVES DURING SCATTERING ON ELECTRON DENSITY FLUCTUATIONS. Apresyan, L. A. (Radiotechnical Inst., Moscow). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 2, 300-302(1975). (In Russian).

The quantitative evaluation of the stability criteria under conditions of multiple scattering is examined for the simplest case of a point isotropic source in a statistically homogeneous plasma with propagated fluctuations of the electron density. (JSR)

28741 RESISTIVE ELECTROSTATIC ION CYCLOTRON INSTABILITY IN PLASMAS. Lee, K. F. (Chinese Univ., Hong Kong); Luhmann, N. C. Jr. IEEE Trans. Plasma Sci.; PS-4: No. 1, 40-44(Mar 1976).

The stability of electrostatic ion cyclotron waves propagating obliquely with respect to the background magnetic field is studied for collisional, fully-ionized plasmas in which there is a relative

field-aligned streaming between electrons and ions. It is found that electron-ion collisions, in conjunction with electron streaming, provides a mechanism for instability. The role of electron streaming is to supply a source of free energy and the role of electron-ion collisions is to restrict the field-aligned mobility of the electrons, thus preventing them from establishing a Boltzmann equilibrium. Ion-ion collisions and finite ion Larmor radius are found to exert a stabilizing influence. The instability is analyzed for both current-carrying plasmas and counterstreaming-beam-plasma systems.

28742 EFFECT OF TRANSVERSE DISPLACEMENT OF A RELATIVISTIC ELECTRON BEAM EXCITATION OF A MONOTRON. Karpov, Y.M. (A. M. Gorky Kharkov State University). Sov. Phys.—Tech. Phys. 20: No. 8, 1115-1117 (Aug 1975).

It is shown that taking account of the interaction of the beam electrons with a transverse microwave field in a relativistic travelling-wave monotron leads to excitation in a new zone corresponding to low transit angles. (auth)

28743 PARAMETRIC INSTABILITIES IN DENSITY MODULATED RELATIVISTIC ELECTRON BEAM PLASMA INTERACTION. Basu, B.; Taussig, R.T. (Columbia University, New York, New York 10027). Phys. Fluids 19: No. 4, 536-544 (Apr 1976).

Parametric coupling between negative energy beam synchronous modes and positive energy plasma oscillation modes of a uniform beam-plasma system, due to the presence of sinusoidal density modulation in the monoenergetic, relativistic electron beam, have been theoretically investigated on the basis of linearized Vlasov–Poisson equations using a multiple-time-scale perturbation theoretical approach. It has been found that, for a given beam-to-plasma density ratio, there exists an upper limit to the initial beam energy for which the instabilities can be excited. Within the allowed range, maximum linear growth rate exhibits a minimum as the beam energy increases from its nonrelativistic value. To determine the effectiveness of the parametric interaction process, feedback effects of the instabilities on the beam-plasma distribution functions have also been considered and estimates of energy transfers have been made. For typical parameters, the beam is found to lose about 15% of its initial kinetic energy during the "hydrodynamic" stage and the time required is about 4.72 nsec. (auth)

28744 LINEAR PARAMETRIC INSTABILITIES AT HIGH-PUMP POWERS. Roderick, N.F. (Department of Aeronautics, United States Air Force Academy, Colorado 80840). Phys. Fluids 19: No. 4, 545-547 (Apr 1976).

The linear parametric decay and oscillating two-stream instabilities have been studied at high-pump power for perturbations propagating oblique to the pump field. The electrostatic Vlasov–Poisson system for a homogeneous two-component plasma has been solved numerically to investigate the high-frequency branches of these instabilities. Results show that the maximum growth rate of the oscillating two-stream instability occurs oblique to the pump field for power levels above a critical value. The angular dependence of this growth rate is dependent on the electron-ion mass ratio. For these cases, the maximum value of the oscillating two-stream growth rate remains constant for increasing power above the critical level while the direction of maximum growth rate becomes more oblique to the pump field and the volume in k space of the unstable region increases. The maximum value of the parametric decay growth rate increases with increasing power level and occurs parallel to the pump field for all values of pump intensity investigated. (auth)

28745 DESTABILIZATION OF THE TRAPPED-ELECTRON MODE BY MAGNETIC CURVATURE DRIFT RESONANCES. Adam, J.C.; Tang, W.M.; Rutherford, P.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 19: No. 4, 561-566 (Apr 1976).

Electron curvature drift resonances, ignored in earlier work on the trapped-electron modes, are found to exert a strong destabilizing influence in the lower collision frequency range of these instabilities. Effects arising from ion temperature gradients, shear, and finite ion gyroradius are included with these ∇B drifts in the analysis, and the resultant eigenvalue equation is solved by numerical procedures rather than the commonly used perturbation techniques. For typical tokamak parameters the maximum growth rates are found to be increased over earlier estimates by roughly a factor of 4, and requirements on magnetic shear strength for stabilization are likewise more severe and very difficult to satisfy. For inverted density profiles, this new destabilizing effect is rendered ineffective, with the result that the modes can be stabilized for achievable values of shear provided the temperature gradients are not too severe. Estimates of the particle and thermal energy transport are given for both normal and inverted profiles. (auth)

28746 RESISTIVE INSTABILITIES IN A TOKAMAK. Glasser, A.H.; Greene, J.M.; Johnson, J.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 19: No. 4, 567-574 (Apr 1976).

Application of resistive instability theory shows that toroidal effects can stabilize the tearing mode in devices like the Princeton Large Torus. Contraction of the current channel is destabilizing. Finite fluid compressibility is crucial to this phenomenon. (auth)

28747 EXTRAORDINARY-MODE ELECTROMAGNETIC INSTABILITY WITH GENERALIZED DISTRIBUTION FUNCTIONS. Lai, C.S. (Department of Physics, University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada). Phys. Fluids 19: No. 4, 575-578 (Apr 1976).

The extraordinary-mode electromagnetic instability associated with the plasma waves propagating perpendicular to the magnetic field is studied for the class of the plasma distributions of the Dory–Guest–Harris type. For $j \geq 2$ distributions, the instability may occur in both low-β and high-β plasmas and is very sensitive to the value of Ω^2_e/ω^2_{pe}. It turns out that the electrostatic instability for the $k_\parallel = 0$ waves is just a special case of the extraordinary-mode instability under the condition $c \to \infty$. (auth)

28748 ELECTROMAGNETIC CURRENT INSTABILITIES. Gary, S.P.; Gerwin, R.A.; Forslund, D.W. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). Phys. Fluids 19: No. 4, 579-586 (Apr 1976).

Linear electromagnetic waves in an infinite, homogenous current-carrying Vlasov plasma with ion $\beta \simeq 1$ are considered. Three instabilities emerge: a long wavelength, "kink-like" mode, and two instabilities with wavenumbers greater than the reciprocal ion Larmor radius, the "electromagnetic ion acoustic instability" and the "whistler current instability." The linear properties of these instabilities are investigated in detail; they have substantially lower thresholds than the electrostatic ion-acoustic instability, and are generally favored by increasing ion β. In the regime of linear growth, the whistler current instability can give rise to an anomalous resistivity, and preferentially heats the ions. (auth)

28749 MODULATIONAL INSTABILITY OF A FINITE AMPLITUDE ALFVÉN WAVE. Lashmore-Davies, C.N. (Euratom-United Kingdom Atomic Energy Authority Association for Fusion Research, Culham Laboratory, Abingdon, Oxon. OX14 3DB, United Kingdom). Phys. Fluids 19: No. 4, 587-589 (Apr 1976).

Conditions are derived for the break-up of a finite amplitude Alfvén wave into upper and lower sideband waves and a longitudinal disturbance. This instability can occur over a much wider range of conditions than the decay instability. The longitudinal disturbance is only nonoscillatory when dissipation is neglected. (auth)

28750 STABILITY AND SPECTRA OF THE BUMPY θ PINCH. Cayton, T.E.; Vahala, G. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). Phys. Fluids 19: No. 4, 590-595 (Apr 1976).

Finite wavelength modes in the bumpy θ pinch are examined by performing perturbation expansions in the small bumpiness on the equations of ideal magnetohydrodynamics. The unstable modes are transverse and compressible. The evolution of two unstable classes of modes from a single unstable class is followed numerically as the plasma β is varied. (auth)

28751 CURRENT PENETRATION AND PLASMA DISRUPTION. Stix, T.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 36: No. 10, 521-524 (8 Mar 1976).

It is suggested that, in a tokamak discharge, the initial rapid current penetration and the disruptive instability may each be attributed to a type of nonlinear double-tearing instability which causes growth and overlap of radially separated magnetic islands. The ensuing reconnection and braiding of magnetic lines would enhance local radial heat and particle transport and could permit rapid redistribution of plasma current, inducing positive or negative spikes in the loop-voltage signal. (auth)

28752 MAGNETIC BRAIDING DUE TO WEAK ASYMMETRY. Rechester, A.B.; Stix, T.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 36: No. 11, 587-591 (15 Mar 1976).

Magnetic surfaces for a plasma with a helical current perturbation $\sim \epsilon^2$ are destroyed by toroidal effects or by a second current perturbation, of incommensurate helicity, and the behavior of magnetic field lines becomes stochastic in layers of relative width $\epsilon^{-l} \times \exp(-\pi/2\epsilon)$, where $l \simeq 2|m_1/m + 1$ with m and m_1 the aximuthal mode numbers of the original helical field and of the perturbation. (auth)

28753 STUDY OF THE CURRENT-DRIVEN ION-ACOUSTIC INSTABILITY USING CO_2-LASER SCATTERING. Slusher, R.E.; Surko, C.M.; Moler, D.R. (Bell Laboratories, Murray Hill, New Jersey 07974); Porkolab, M. Phys. Rev. Lett. 36: No. 12, 674-677 (22 Mar 1976).

The saturated state of the current-driven ion-acoustic instability in a He positive-column plasma is studied using CO_2-laser scattering and

heterodyne detection. It is found that small concentrations of hydrogen present in the positive-column plasma play a crucial role in saturating the instability. The measured angular extent and level of saturation of the turbulence are found to be consistent with "resonance-broadening"-enhanced ion Landau damping by 1 to 4% H^+ impurity ions. (auth)

28754 INHIBITION OF THE CURRENT-DRIVEN ION-WAVE INSTABILITY IN THE TRAPPED-ELECTRON REGIME IN THE FM-1 SPHERATOR. Arunasalam, V.; Okabayashi, M.; Hawryluk, R.J.; Suckewer, S. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 36: No. 13, 726-729 (29 Mar 1976).

An experimental analysis is made of the scattering of microwaves by the density fluctuations due to the current-driven ion-wave instability in a toroidal plasma confinement device, the FM-1 spherator. It is found that the instability exists in the collisional regime and it is inhibited (i.e., quenched by two order of magnitude) in the trapped-electron (i.e., banana) regime. The inhibition occurs when the electron collision frequency is about equal to the electron bounce frequency between mirror trapping. (auth)

28755 COUPLING SATURATION IN THE NONLINEAR THEORY OF PARAMETRIC DECAY INSTABILITIES. Bezzerides, B.; DuBois, D.F. (Theoretical Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). Phys. Rev. Lett. 36: No. 13, 729-732 (29 Mar 1976).

A new saturation mechanism for the nonlinear stage of parametric decay instabilities arises from pump-induced cross-correlations between Fourier modes. These correlations result in a renormalization—usually a reduction—of the mode coupling coefficients. Coupling saturation arises from the same order of approximation as the familiar induced-scattering nonlinearity. When applied to the $2\omega_{pe}$ decay instability and the electron-ion decay instability, coupling saturation greatly reduces the turbulent wave energy compared to earlier calculations. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 28426, 28686, 28824, 28850, 28851, and 30172.

28756 (BNL-20840) ACCELERATOR-BASED NEUTRON GENERATOR (ADDENDUM). Grand, P. (Ed.). (Brookhaven National Lab., Upton, N. Y. (USA)). Jan 1976. 45p. Dep. NTIS $4.00.

A proposal to design, construct, and operate a D–Li intense neutron source for CTR materials research is discussed. Information pertaining to the following areas is given: (1) radiation damage effectiveness, (2) Linac design and performance, (3) target design and performance, (4) experimental area design, (5) construction schedule, (6) construction costs, (7) preliminary design and development program, (8) facility operation and operating costs, and (9) financial appropriation plan. (MOW)

28757 (CONF-760209-18) ENERGY DEPENDENT NEUTRON SPUTTERING AND SURFACE DAMAGE CROSS SECTIONS. Odette, G. R.; Doiron, D. R.; Kennerley, R. J. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 24p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

The results clearly indicate that damage function analysis might be usefully applied to define both the neutron and primary recoil energy dependence of sputtering yields. Even with relatively large data errors, it appears that it is possible to both detect the existence and indicate the form of the deviation of sputtering yield from linear damage energy dependence (if such deviation exists). This information would be very useful in developing improved models of the sputtering phenomena.

28758 (CONF-760209-19) PHOTON EMISSION PRODUCED BY PARTICLE-SURFACE COLLISIONS. White, C. W.; Tolk, N. H. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. 15p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

Visible, ultraviolet, and infrared optical emission results from low-energy (20 eV-10 keV) particle-surface collisions. Several distinct kinds of collision induced optical radiation are discussed which provide fundamental information on particle-solid collision processes. Line radiation arises from excited states of sputtered surface constituents and backscattered beam particles. This radiation uniquely identifies the quantum state of sputtered or reflected particles, provides a method for identifying neutral atoms sputtered from the surface, and serves as the basis for a sensitive surface analysis technique. Broadband radiation from the bulk of the solid is attributed to the transfer of projectile energy to the electrons in the solid. Continuum emission observed well in front of transition metal targets is believed to arise from excited atom clusters (diatomic, triatomic, etc.) ejected from the solid in the sputtering process. Application of sputtered atom optical radiation for surface and depth profile analysis is demonstrated for the case of submonolayer quantities of chromium on silicon and aluminum implanted in SiO_2.

28759 (CONF-760209-20) COMPUTER STUDIES OF THE SCATTERING OF LOW ENERGY HYDROGEN IONS FROM POLYCRYSTALLINE SOLIDS. Oen, O. S.; Robinson, M. T. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. 13p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

Reflection of 50 eV to 10 keV H atoms from polycrystalline Cu, Nb and Au targets has been calculated using the binary collision cascade program MARLOWE. The fractions of particles and energy reflected (backscattered) increase with increasing atomic number of the target and decrease with increasing incident energy. The results indicate that the effects of polycrystallinity are modest, reducing the amorphous reflection coefficients by about 25 percent. The calculations agree quite well with the experimental data for Cu and Au, but are about a factor of two larger than is observed for Nb.

28760 (EUR-CEA-FC-782) ERGODISATION OF MAGNETIC SURFACES IN TOKAMAKS. Samain, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Aug 1975. 31p. INIS.

A turbulence mechanism which could explain the internal disruptions and the negative spikes which are observed in Tokamaks is discussed. If the flux lines become ergodic between two magnetic surfaces $r = r_1$ and $r = r_2$ $r_1 < r_2$, this ergodicity tends to flatten the current density profile between r_1 and r_2, and this eventually induces a large electric field E, positive on the side $r = r_1$ and negative on the side $r = r_2$. Due to the radical magnetic connections, the positive and the negative values of E tend to cancel each other along the flux lines, and the field E may exist although the current density experiences a small change in the interval $(r_1 r_2)$. However, the field E induces by skin effect spatial pulses of current density in the unperturbed domain near $r = r_1$ and $r = r_2$. These pulses may drive unstable tearing modes with large transverse wave numbers, and so extend the domain $(r_1 r_2)$ where the ergodicity takes place. The first step of the phenomena could be a tearing instability of the separatrix of the magnetic islands which are normally present near the magnetic surface $q = 1$ or $q = 2$. (FR)

28761 (INIS-mf-1869) THERMONUCLEAR FUSION–THE CHIEF ENERGY SOURCE OF THE UNIVERSE ADVANCES TOWARDS ITS HARNESSING IN THE NEAR FUTURE. Pais, Y. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Sep 1974. vp. (In Hebrew). INIS.

From national symposium on energy; Netanya, Israel (19 Mar 1974).

Published in "The National Symposium on Energy, Netanya, Israel, 19-21 Mar 1974", edited by Perath, I.; Ministry of Commerce and Industry, Jerusalem (Israel); Natural Resources Research Administration, Israel, Sep 1974, p. 495-505.

A review is given of the thermonuclear fusion process, the fuel, the fusion reactor and the Israeli advances in this direction.

28762 (MATT-1225) PLT NEUTRAL INJECTION IGNITRON ACCELERATING SUPPLY. Ashcroft, D. L.; Murray, J. G.; Newman, R. A.; Peterson, F. L. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Mar 1976. Contract E(11-1)-3073. 12p. Dep. NTIS $3.50.

A phase-controlled rectifier has been designed for the accelerating supply on the PLT Neutral Beam Injection system at PPPL. The rectifier must furnish 70 amperes at up to 50 KV for 300 milliseconds, with a duty cycle of up to 10 percent. Protection of the injectors requires the supply to withstand repeated crowbarring. The rectifying element selected to satisfy these requirements was a commercially-available ignitron, installed in a supporting frame and using firing circuits and controls designed by PPPL.

28763 (ORNL/TM-5198) UNCERTAINTIES IN CALCULATED HEATING AND RADIATION DAMAGE IN THE TOROIDAL FIELD

COIL OF A TOKAMAK EXPERIMENTAL POWER REACTOR DUE TO NEUTRON CROSS-SECTION ERRORS. Alsmiller, R. G. Jr.; Barish, J.; Weisbin, C. R. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 67p. Dep. NTIS $6.00.

Calculated results are presented of the uncertainties in the neutron scalar flux, the energy deposition per unit volume, and the displacements per atom in the toroidal field coil of a tokamak experimental power reactor due to neutron cross-section errors in iron and carbon which are major constituents of the blanket-shield-coil configuration considered. The calculations were carried out using perturbation theory to obtain sensitivity profiles for the various cross sections of interest, and these profiles were then combined with cross-section error estimates, including correlations, to obtain the uncertainties. Each of the three responses—the neutron scalar flux, the energy deposition per unit volume, and the displacements per atom—is found to be very sensitive to the cross sections in the energy group which contains the source (approximately 14 MeV since a D-T source is assumed), and each of the responses is found to have a relative standard deviation of approximately 100 percent due to neutron cross-section errors in iron.

28764 (UCID-17076) DT FUSION NEUTRON IRRADIATION OF BNL-LASL SUPERCONDUCTOR WIRES, BPNL GRAPHITE IRRADIATION CAPSULE, AND LLL KEVLAR 49. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jan 1976. Contract W-7405-Eng-48. 13p. Dep. NTIS $3.50.

The procedure for performing the neutron irradiation experiment is described. No results are given. (MOW)

28765 TORUS VACUUM CAPACITOR WITH MAGNETIC INSULATION FOR ELECTRIC POTENTIALS IN THE GV RANGE. Krastelev, E. G. Arch. Energiewirtsch.; 29: No. 8, 799-804 (Aug 1975). (In German)

3 figs.; 5 refs. Also published in At. Tekh. Rubezom (1975), (No. 2) p. 42-45.

A torus capacitor is described whose inner torus electrode is suspended in a vacuum by an auxiliary magnetic field. Estimations for this system—which has not yet been realized—suggest that a shock output of about 10^{15} watt may be expected for charge and discharge frequencies <100 Hz. Various fields of application—especially the initiation of D-T nuclear fusion reactions—are discussed. (GE)

28766 COMPUTER CONTROLLED 125 MVA POWER SUPPLY FACILITY FOR NUCLEAR FUSION RESEARCH. Miyahara, A.; Bannai, E.; Kitano, Y. Toshiba Rev., Int. Ed.; No. 94, 7-13 (1974).

A flywheel-type motor generator power source required to confine high temperature plasma in nuclear fusion research is described. The Toshiba 125 MVA power generation facility to be delivered to the Institute of Plasma Physics, Nagoya University is described. The generator has an output of 100 MW with a one-second flat-top and is controlled by a direct digital control system. (auth)

28767 PLASMA MHD GENERATOR FOR MODELLING THE TRANSFORMATION OF ENERGY OF PULSED THERMONUCLEAR REACTORS. Velikhov, E. P.; Volkov, Yu. M.; Golubev, V. S.; Lobanov, N. V.; Rutberg, F. G.; Yakushev, A. A. At. Energ. (USSR); 39: No. 6, 387-391(Dec 1975). (In Russian).

A design project for a model pulse MHD-generator of the Faraday type with continuous electrodes and lithium plasma is considered in this paper. The parameters of the working body in the chamber of the plasmatron are $p_* = 400$ bar and $T_* = 12 \times 10^3$ K. The purpose of the project is the investigation of problems associated with the construction of a plasma-type MHD-generator for use with a thermonuclear reactor and problems of achieving a high coefficient of conversion of thermal energy into electricity with quasi-stationary MHD-generators. (auth)

28768 ROLE OF HYBRID REACTORS IN THE WORLD'S ENERGY SYSTEM. Golovin, I. N. At. Energ. (USSR); 39: No. 6, 379-386(Dec 1975). (In Russian).

The future role in the world's energy system of hybrid thermonuclear reactors using magnetic confinement is considered. Parameters of hybrid reactors using ignition and external injection are presented. The following confinement laws are assumed: neoclassical, empirical, and one-hundred Bohm lifetimes. (auth)

28769 INVESTIGATION OF THE PRODUCTION OF PLASMAS FROM LIQUID DROPLETS. MacEwen, H. A. Washington, DC; Catholic Univ. of America (1975). 300p. University Microfilms Order No. 75-20,049.

Thesis (Ph.D.).

Since laser plasmas have not been created using small, transparent liquid bodies as targets, a preliminary investigation into the phenomena that arise in such plasmas was undertaken. Small (0.1 mm to 1.0 mm diameter) droplets of water freely falling in a partial vacuum (0.1 atm to 0.7 atm) were irradiated by a Q-switched ruby laser (around 10 Mw power at 6943 A wavelength). The resultant plasma was seen to be highly asymmetric; an initial expansion away from the laser was immediately followed by an expansion back towards the laser. Using a moderately simple computer model, these phenomena were seen to be generally explainable in terms of classical geometrical optics, which requires an early focusing of the incident radiation to very high energy densities near the backside of the target droplet. (Diss. Abstr. Int., B)

28770 ION-SOLID INTERACTION IN FUSION REACTORS. Scherzer, B.M.U. (California Institute of Technology, Pasadena, California 91125). J. Vac. Sci. Technol. 13: No. 1, 420-428 (Jan 1976).

The impact of energetic ions and atoms from the plasma on the first wall causes serious problems in achieving and maintaining a thermonuclear plasma. Simple model calculations show that sputtering by working gas particles is the main source of impurities in the plasma. Wall erosion is estimated to be up to ~0.1 mm/yr. Recent experiments show that blistering due to ions and atoms in the mean energy range of the plasma particles (1–20 keV) does not contribute to wall erosion and may be completely avoided. The charge and energy distributions of working gas particles backscattered from the first wall is largely responsible for the impact of high energy resonant charge exchange neutrals on the wall. The energy distribution of backscattered neutrals differs significantly from that of ions. High amounts of gas may be trapped in the first wall, but a reemission factor of one will be attained for most materials after a short starting period. High trapping efficiencies for hydrogen even at very high doses are found in materials like Ti and Zr. This may be helpful in increasing the pumping efficiency of a divertor. (auth)

28771 MEASUREMENT AND MODIFICATION OF FIRST-WALL SURFACE COMPOSITION IN THE OAK RIDGE TOKAMAK (ORMAK). Clausing, R.E.; Emerson, L.C.; Heatherly, L. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Colchin, R.J.; Twichell, J.C. J. Vac. Sci. Technol. 13: No. 1, 437-442 (Jan 1976).

Impurities coming into the plasma from the walls of present-day toroidal plasma confinement devices modify plasma behavior substantially. Small fractions of high-Z ions in the plasma greatly decrease plasma temperatures and increase plasma energy losses. We are attempting to identify and control the sources of impurities from the "first-wall" in ORMAK. Auger electron spectroscopy, soft x-ray appearance-potential spectroscopy, and other surface-sensitive techniques have been used to characterize the surface composition of the first wall and to develop methods to remove carbon and oxygen. Oxygen glow-discharge cleaning has been shown, in the laboratory, to be an effective way of removing carbon from gold films (simulated ORMAK liner material) and the use of oxygen-discharge cleaning in ORMAK has resulted in a decrease in plasma contamination, a 50% increase in plasma current, and an accompanying increase in plasma temperature. In spite of these improvements the walls of ORMAK are far from clean. Substantial amounts of carbon, oxygen, iron, and other elements remain. (auth)

28772 GRAPHITE SURFACE EROSION AND BLISTERING. Feinberg, B.; Post, R.S. (University of Wisconsin, Madison, Wisconsin 53706). J. Vac. Sci. Technol. 13: No. 1, 443-446 (Jan 1976).

Bulk reactor-grade graphite and WCA graphite cloth were exposed to an atom and ion beam produced in a Hall accelerator. Samples exposed to hydrogen received a total dose of 10^{20} atoms/cm^2 of 580-eV mean energy H^0 and 5×10^{18} ions/cm^2 of 875-eV mean energy H^+. Samples exposed to helium received a total dose of 10^{20} atoms/cm^2 of He^0 and 5×10^{18} ions/cm^2 of He^+. During irradiation, the pressure in the sample region was governed by the partial pressure of the source gas (H_2or He) and was at 47 mPa. The samples were then examined with a scanning electron microscope and an optical interference microscope to determine the surface damage. Upon exposure to H^0 and H^+, the bulk graphite and the graphite cloth samples showed substantial surface erosion. The amount of erosion was found to be strongly dependent on the sample surface temperature. Upon exposure to He^+, blistering was observed on the graphite cloth sample. No measurable surface erosion of the samples exposed to He was observed with the scanning electron microscope. (auth)

28773 VACUUM AND WALL PROBLEMS IN PRECURSOR REACTOR TOKAMAKS. Cohen, S.A. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). J. Vac. Sci. Technol. 13: No. 1, 449-462 (Jan 1976).

The Princeton Large Torus (PLT) will be completed in 1975 and two other CTR-oriented toroidal plasma devices, the Poloidal Divertor Experiment (PDX) and the Tokamak Fusion Test Reactor (TFTR), are planned to be completed in 1977 and 1981. The vacuum systems of

these machines must satisfy stringent requirements because of unusual operating conditions, such as, magnetic-field-induced strains and eddy currents, energetic particle and photon bombardment, large transient gas loads, and the use of 100 Ci quantities of tritium. In addition, novel vacuum wall surfaces and fast moving mechanical or magnetic plasma limiters will be required to minimize the influx of impurities during discharges. (auth)

28774 THE TOKAMAK AND ITS BROTHERS. Klingelhofer, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Kernverfahrenstechnik). Exakt.; No. 9, 52-53(1974). (In German).

The chronology of the Tokamak development and the present state of development in various countries are described. The operational principle of the Tokamak and the related Stellarator are outlined. According to the author, the fuel supply of fusion reactors is secured, but there are still some technological problems to be solved. (DE)

28775 DISCRETE COIL TORUS WITH LOWER FIELD RIPPLE. Sheffield, G. V. (Princeton Univ., NJ). IEEE Trans. Plasma Sci.; PS-4: No. 1, 72-74(Mar 1976).

A new toroidal field coil configuration is described which allows one to reduce the volume of a toroidal field coil system or the number of coils constituting such a system without increasing the toroidal field ripple.

28776 400 kJ ENERGY BANK FOR SUPPLYING A FOCALIZING ELECTRICAL DISCHARGE. Feugueur, G.; Coudurier, J.; Hellegouarch, J. Tech. CEM (Cie. Electr.-Mec.); No. 90, 24-27 (Jun 1974). (In French).

A bank of capacitors is described that is capable of supplying 400 kJ in a few microseconds for studying the electrical discharges, especially the neutron emission in rapid thermonuclear fusion with a view to using it as an energy source. The principles and operation of a focus plasma source with which the bank is to operate, are described and the electrical characteristics of the discharge are given. The 400 kJ bank is made up of 12 modules each consisting of 10 capacitors connected by 40 coaxial cables with three-electrode spark gaps as switches and a single master spark gap. A synchronous triggering system for the spark gaps and a remote control system are also incorporated. (Electr. Electron. Abstr.)

28777 PARAMETRIC STUDY OF THE CURRENT INDUCED IN A CO_2 LASER PLASMA. Drouet, M.G. (Direction Sciences de Base, Institut de Recherche de l'Hydro-Québec, Varennes, Québec, Canada J0L 2P0); Pépin, H. Appl. Phys. Lett. 28: No. 8, 426-428 (15 Apr 1976).

The current generated during the interaction of a focused 10.6-μm CO_2 nanosecond laser pulse with a copper target was measured as a function of laser power—up to 2.5 GW—and of the background nitrogen pressure from 10^{-5} to 10^{3} Torr. Current distribution at the target was measured. The results show a resonance effect at 10^{-2} Torr with a total current flow of 250 kA. (auth)

28778 REMOTE OPERATIONS IN A FUSION ENGINEERING RESEARCH FACILITY (FERF). Doggett, J. N. (Univ. of California, Livermore). Conf. Remote Syst. Technol., Proc.; 23: 11-19(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The proposed Fusion Engineering Research Facility (FERF) has been designed for the test and evaluation of materials that will be exposed to the hostile radiation environment created by fusion reactors. Because the FERF itself must create a very hostile radiation environment, extensive remote handling procedures will be required as part of its routine operations as well as for both scheduled and unscheduled maintenance. This report analyzes the remote-handling implications of a vertical- rather than horizontal-orientation of the FERF magnet, describes the specific remote handling facilities of the proposed FERF installation, and compares the FERF remote handling system with several other existing and proposed facilities.

28779 INTRODUCTION TO TRITIUM TECHNOLOGY. Meyer, L. H. (E. I. du Pont de Nemours and Co., Aiken, SC). Conf. Remote Syst. Technol., Proc.; 23: 53-54(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The technology of tritium, including its production and its interaction with confining metals, has been under extensive development for over 30 years. This technology is a potentially valuable resource for the fusion reactor program. However, much of it is not readily available because of classification.

28780 TRANSFER OPERATIONS WITH TRITIUM: A REVIEW. Folkers, C. L.; Gede, V. P. (Univ. of California, Livermore). Conf. Remote Syst. Technol., Proc.; 23: 55-63 (1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

Controlled thermonuclear reactors will involve pumping operations with tritium that may involve pressures ranging from submillipascals to megapascals. A variety of pumps is available that can cover portions of this range, and these can be staged to cover the entire pressure range. Some of these pumps can be adapted to virtually any size requirement currently anticipated. Special attention must be paid to operating features and construction materials.

28781 NUCLEAR DESIGN OF THE BLANKET/SHIELD SYSTEM FOR A TOKAMAK EXPERIMENTAL POWER REACTOR. Abdou, M. A. (Argonne National Lab., IL). Nucl. Technol.; 29: No. 1, 7-36(Apr 1976).

The various options and trade-offs in the nuclear design of the blanket/shield for a Tokamak Experimental Power Reactor (TEPR) are investigated. The TEPR size and cost are particularly sensitive to the blanket/shield thickness, DELTA/sub BS/, on the inner side of the torus. Radition damage to the components of the superconducting magnet and refrigeration power requirements set lower limits on DELTA/sub BS/. These limits are developed in terms of TEPR design parameters such as the wall loading, duty cycle, and frequency of magnet anneals. The study of the nuclear performance of various material compositions shows that mixtures of tungsten, or tantalum, or stainless-steel alloys and boron carbide require the smallest DELTA/sub BS/ for a given attenuation. This DELTA/sub BS/ has to be doubled if the low induced activation materials graphite and aluminum are used. The space problems are greatly eased in the Argonne National Laboratory ANL-TEPR reference design by using two separate segments of the blanket/shield. The inner segment occupies the region of the high magnetic field, uses very efficient attenuators (tungsten- or tantalum- or stainless-steel-boron carbide mixtures), and is only 1 m thick. The outer blanket/shield is 131 cm and consists of an optimized composition of stainless steel and boron carbide. For the design parameters of 0.2 MW/m^2 neutron wall loading and 50 percent duty cycle, the reactor components can operate satisfactorily up to (a) 10 yr for the stainless-steel first wall, (b) 10 yr for the superconductor composite after which magnet warmup becomes necessary, and (c) 30 yr for the Mylar insulation. Nuclear heat generation rates in the blanket/shield and magnet are well within the practical limits for heat removal.

28782 CALCULATED COMPOSITION CHANGES OF SOME REFRACTORY METALS IN A FUSION REACTOR ENVIRONMENT. Kopecki, D. S.; Ralls, K. M.; Draper, E. L. Jr. (Univ. of Texas, Austin). Nucl. Technol.; 29: No. 1, 98-107(Apr 1976).

Composition changes that occur during neutron bombardment have been calculated for the first wall of a hypothetical fusion reactor. The first wall materials studied are pure niobium, zirconium, molybdenum, and vanadium, and some of their binary alloys. Two integrated neutron flux intensities, 3.8×10^{14} n/(cm^2 sec) and 3.8×10^{15} n/(cm^2 sec) up to a fluence of 3.6×10^{23} n/cm^2, have been used in the calculations of the first three materials. In addition, the composition as a function of fluence (maximum fluence equals 4.0×10^{23} n/cm^2) has been calculated for a vanadium wall. Graphs for each material have been plotted to show the variation of composition as a function of time and/or fluence. Rates of production of hydrogen and helium have been calculated for all four materials; comparisons for niobium and vanadium walls with literature values show agreement that it is not poor. Furthermore, mixture diagrams have been constructed for two binary alloy systems, niobium-zirconium and niobium-vanadium, to relate composition at constant irradiation time to the initial composition.

28783 DIRECT ENERGY RECOVERY SYSTEM USING PERIODIC FOCUSING WITHOUT GRIDS. Barr, W. L.; Howard, B. C. (Univ. of California, Livermore). IEEE Trans. Plasma Sci.; PS-1: No. 4, 76-80(Dec 1973).

Results from a computational study of the efficiency of a direct energy recovery system are presented. This system is similar to R.F. Post's original (gridless) periodic-focus system. However, the computer code used here allows more flexibility than that used by Post. His code requires analytic expressions for the potentials; this code requires only the values of potential on the boundaries. Consequently, the code can be applied to systems where analytic expressions have not been written for the potential. The incident beam used in this study had an average thickness of 0.42 m (as might be expected in an ideal reactor situation) and a maximum divergence angle of $+3.3^{0}$. Each of the systems tested, when operating at optimum efficiency, recovered 80 percent of the energy, as compared to 91 percent for Post's gridded periodic system. (Electr. Electron. Abstr.)

Wave Phenomena

Refer also to abstract 30581.

28784 (AD/A-008246) MECHANISM FOR ESTABLISHING STEADY PLASMA TURBULENCE. Akhiezer, I. A.; Angeleiko, V. V. Translated from Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 9, 1431-1437(1972). 12p. (FSTC-HT-23-1887-73). NTIS $3.25.

A mechanism for establishing steady plasma turbulence is described. Owing to nonlinear effects, the phase velocity of the plasma wave is modified, proportional to the level of turbulent oscillations. Ion-acoustic oscillations in a strongly magnetized, collision-free plasma containing thermal electrons are considered. (GRA)

28785 (IPPCZ-168) PENETRATION OF HIGH-FREQUENCY WAVES INTO A WEAKLY INHOMOGENEOUS MAGNETIZED PLASMA AT OBLIQUE INCIDENCE AND THEIR TRANSFORMATION TO BERNSTEIN MODES. Preinhaelter, J.; Kopecky, V. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Sep 1972. 28p. INIS.

The propagation of high-frequency electromagnetic waves in a weakly inhomogeneous magnetized plasma is investigated. The density gradient is assumed to be perpendicular to the external magnetic field and the waves to be incident obliquely upon the plasma from vacuum. The transmission coefficient of the ordinary wave through the plasma resonance is found to be approximately equal to one in a fairly wide range of angles of incidence γ about the value $\gamma_0 = \arcsin\sqrt{\omega_c/(\omega_c + \omega)}$. The transmitted ordinary wave is, at high densities, completely transformed into an extraordinary wave. It then propagates back to the region of lower density and is completely transformed into the Bernstein modes in a site of hybrid resonance. Difficulties with the evanescent layer connected with high-frequency energy transmission into the plasma in the form of an extraordinary wave can thus be removed by using the ordinary wave with the angle of incidence appropriately chosen. (auth)

28786 (PB-238960) WAVE PACKETS IN AN ABSORPTIVE AND STRONGLY DISPERSIVE MEDIUM. Research Report. Anderson, D.; Askne, J.; Lisak, M. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden)). Sep 1974. 35p. (RR-122). NTIS $3.75.

The evolution of slowly varying wave pulses in strongly dispersive and absorptive media is studied by recursive and "Schrodinger" methods. It is shown that the resulting envelope function may be obtained by including correction terms of arbitrary dispersive and absorptive order. Different concepts of pulse velocity are discussed in some detail. The initial pulse form and the dispersion relation describing the medium determine the character of the pulse velocity. Finally, qualitative examples of a Gaussian pulse in a cold plasma and an atomic medium are given, which illustrate the importance of higher-order terms. (GRA)

28787 PARAMETRIC EXCITATION OF ELECTROMAGNETIC WAVES IN MAGNETIZED PLASMAS. Kaw, P. K. (Physical Research Lab., Ahmedabad, India). pp 207-236 of Advances in Plasma Physics. Vol. 6. Kaw, P. K. New York; John Wiley and Sons, Inc. (1976).

The dispersion relation for the stimulated scattering problem is derived using the k · DELTA X method. This method is fully equivalent to the Vlasov–Maxwell set of equations and is much more physically transparent. The dispersion relation is then solved to study the decay instabilities and purely growing modes. (MOW)

28788 COLLECTIVE MODES IN CONFINED HIGH TEMPERATURE PLASMAS. Coppi, B.; Rewoldt, G. (Massachusetts Inst. of Tech., Cambridge). pp 421-585 of Advances in Plasma Physics. Vol. 6. Kaw, P. K. New York; John Wiley and Sons, Inc. (1976).

The properties of the equilibrium particle distribution function in phase space and the particle orbits that are appropriate to axisymmetric toroidal configurations are studied. The general properties of the modes that can be excited in these configurations are discussed. The perturbed ion and electron distribution functions are derived by integration of the linearized Vlasov equation along perturbed guiding center orbits. Various mode cases are described. Both collisional and collisionless effects are considered. (MOW)

28789 PROPAGATION IN A MOVING COMPRESSIBLE PLASMA. Agarwal, D. C. (Univ. of Allahabad, India). Indian J. Phys.; 49: No. 7, 516-520(Jul 1975).

The propagation of electromagnetic waves through a moving compressible plasma is studied. Starting from the fundamental equations, potential equations for such a case were derived. The dispersion relation was also derived.

28790 PROPAGATION OF ELECTROMAGNETIC WAVES IN AN OVERDENSE PLASMA. La Haye, R. J. New York; City Univ. of New York (1975). 124p. University Microfilms Order No. 75-28,086.

Thesis (Ph. D.).

Linearly polarized electromagnetic waves with power densities up to 12 W/cm^2 (f equals 2.45 GHz) are propagated along an external static magnetic field in a cylindrical waveguide. The power is pulsed with a duration of about 4 msec. Plasma with density n approximately 2 x 10^{11}/cc, T/sub e/ approximately 8 ev, and axial length approximately 22 cm (defined by the length of the region which omega/sub rho//omega greater than or equal to 1) is produced by electron cyclotron resonance. At this density the left component of the incident wave is nominally cut off. We find that approximately 25 percent of the left wave power is transmitted through the plasma while a linear theory predicts that less than 0.01 percent of the incident power should tunnel through. Dynamic measurements of the plasma density and electromagnetic field profiles during the transmission period were made and both show a transition from peaked on axis to annular configurations. Transmission of the left wave occurs for a time tau after the beginning of the microwave pulse until at t equals tau it abruptly ceases and the plasma becomes opaque to both the left and right handed incident electromagnetic waves. (Diss. Abstr. Int., B)

28791 EXCITATION AND PROPAGATION OF LOWER-HYBRID WAVES IN AN INHOMOGENEOUS, BOUNDED PLASMA. Colestock, P. L. Ann Arbor, MI; Univ. of Michigan (1975). 235p. University Microfilms Order No. 75-29,192.

Thesis (Ph. D.).

The excitation and propagation of waves near the lower-hybrid frequency in an inhomogeneous, cylindrical plasma are studied experimentally and theoretically for finite-length, electrostatic sources. The boundary-value problem for the electrostatic potential in a cold, inhomogeneous plasma is solved numerically as a superposition of the radial eigenmodes excited by a finite-length source. Radial eigenmodes are found numerically by an algorithm which includes the case where the lower-hybrid resonance layer occurs in the plasma. The effect of collisions and plasma inhomogeneity on the eigenmodes is investigated. The eigenmode superposition is carried out for a split-cylinder source driven either in phase or out of phase. The plasma response is found to be composed of so-called resonance-cone surfaces along which the electrostatic potential is a maximum. At frequencies just above the maximum lower-hybrid frequency in the column, the resonance-cone surfaces are shown to extend over large axial distances from the source before reflecting from the column axis. At frequencies below the maximum lower-hybrid frequency, the resonance-cone surfaces become asymptotic to the lower-hybrid resonance layer. It is shown that collisional damping tends to dissolve the resonance-cone structure leaving the lowest-order eigenmode excited by the source. (Diss. Abstr. Int., B)

28792 WHISTLER WAVE EXPERIMENTS IN A BOUNDED PLASMA. Johnson, M. D. Ithaca, NY; Cornell Univ. (1975). 165p. University Microfilms Order No. 75-27,031.

Thesis (Ph. D.).

This research experimentally studied the propagation of an electromagnetic Whistler wave and its interaction with an electron beam. This required the development of a suitable plasma, the study of wave propagation in a bounded laboratory plasma and the development of an electron beam. The quiescent argon plasma had an electron density typically a few times 10^{12}/cc with an electron temperature of about 3 eV. The plasma was produced with 1 kW at 2.90 Hz in a slow-wave structure in a one kilo-gauss 2 : 1 magnetic mirror field. Small loop antennas were used to launch and receive electromagnetic Whistler waves in the frequency range 0.5 less than omega/OMEGA/sub ce/ less than 0.9. The wave dispersion was measured and found to agree with the infinite cold plasma theory, although other modes were also present. An electron beam was developed to study a simple Landau interaction between the bounded Whistler wave and the beam. The interaction occurs when the parallel beam velocity is approximately equal to the phase velocity of the wave. Good agreement with theory was obtained when realistic beam distribution functions were used. A similar calculation was performed for the Whistler instability where the resonance condition is -vector k · vector v/sub b/ equals OMEGA/sub ce/ - omega. These calculations related the transverse beam energy and the parallel velocity spread to the wave growth. The latter calculations could be used to develop an optimum electron beam to study this interaction in other experiments. (Diss. Abstr. Int., B)

28793 OBSERVATION OF AN OBLIQUELY GROWING MODE IN AN ION-BEAM—PLASMA SYSTEM. Ohnuma, T.; Fujita, T.; Adachi, S. (Department of Electrical Engineering, Tohoku University, Sendai, Japan). Phys. Rev. Lett. 36: No. 9, 471-474 (1 Mar 1976).

By use of a small launcher in an ion-beam—plasma system, a spatially growing mode, which propagates obliquely to the ion beam, was observed. With ion beams, the wave propagation vector was found to be not in the radial direction from the launcher. The observed phase velocity and spatial growth rate of a slow ion-beam—plasma mode are explained by three-dimensional wave theory. (auth)

28794 EXCITATION OF HARMONICS WITH HIGH NUMBERS IN PLASMA. Buts, V. A.; Kovoruchko, S. M. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 2, 185-188(1975). (In Russian).

It is shown experimentally and theoretically that in plasma being in the external electric field, the intensity of which changes periodically in time, there occurs an effective excitation of high numbers of harmonics (up to 77) by the external field frequency. (auth)

28795 PROPAGATION OF PULSE SIGNALS IN A MAGNETO-ACTIVE PLASMA. Novikov, Yu. P. Uch. Zap. Leningr. Gos. Univ., Ser. Fiz. Geol. Nauk; No. 24, 365-377(1974). (In Russian).

The propagation of pulse signals is considered in a cold, homogeneous magnetoactive plasma. Expressions are obtained for the fields during longitudinal propagation of the pulse E(z,t), which is given at $z = 0$ in the form of a δ-function. The expressions which are found for the field correspond to the times $t \ll 1/\omega_H$ and $t \gg 1/\omega_H$ after signal arrival at the point of observation. By an asymptotic method of subtracting integrals (method of saddle points) expressions are obtained for the components of the field of a point, electric dipole, which is oriented along a constant magnetic field at $\omega \ll \omega_H$, which corresponds to the range of auroral atmospherics. The problem of switching on the dipole at time $t = 0$ is considered. The results of this study may be useful to specialists investigating the propagation of low-frequency signals in a plasma close to the earth. 6 refs. (SJR)

28796 NONLINEAR INTERACTIONS NEAR THE PLASMA RESONANCES. Chan, V. S. H. Madison, WI; Univ. of Wisconsin (1975). 180p. University Microfilms Order No. 75-23,836.

Thesis (Ph. D.).

The decay instabilities near the hybrid resonances in a homogeneous plasma in a uniform magnetostatic field are considered. The case of an electron plasma with the extraordinary mode as the pump wave is described. Parametric instability is found to be more difficult to excite as compared to the case when the pump is an ordinary mode. The investigation is extended to the more complicated case when the plasma consists of two species of ions and an ordinary mode is used as the pump. In this case, parametric instabilities can occur only for couplings between an ordinary mode and the three lower frequency branches of the extraordinary mode. The characteristics of the parametrically excited instabilities have been illustrated with the help of appropriate numerical results. The second part of this thesis is concerned with the interaction of two ordinary waves and an extraordinary wave through weak nonlinearity in a uniform, warm, electron plasma. The third part is concerned with the nonlinear self-modulation of large amplitude waves. The last part is concerned with the parametric excitation of the upper hybrid wave in an inhomogeneous, warm, electron plasma. The slow amplitude variation is governed by a parabolic cylinder equation. If the wavenumber mismatch has a linear profile, only spatial amplification is possible. For significant amplification, two separate thresholds result due to convection and damping. If the mismatch has a quadratic profile, absolute instability is possible. It is found that under certain conditions, the inhomogeneities in the number density and the magnetostatic field can combine in such a way as to enlarge the region of absolute instability. Numerical results are included to illustrate these characteristics.

28797 RELATIVISTIC EFFECT OF GUIDED WAVE PROPAGATION THROUGH ISOTROPIC LOSSY PLASMA. Tiwari, G. N.; Singh, D.; Tolpadi, S. K. (Banaras Hindu Univ., India). IEEE Trans. Plasma Sci.; PS-4: No. 1, 62-65(Mar 1976).

The dispersion relations and cut-off frequencies for the appropriate modes existing inside the relativistically moving lossy isotropic plasma waveguide are studied and are found to depend on waveguide dimensions, plasma-parameters and the drift velocity of plasma medium. The field as well as power flow are also studied in detail and it is found that the fields as well as power flow for TE modes are unchanged while for TM modes they are modified depending on the drift velocity of the plasma medium. The results are compared with those obtained for the case of lossless relativistically moving and lossy stationary plasma waveguides.

28798 SCATTERING FROM A BOUNDED PLASMA. Bhartia, P. (Univ. of Regina, Saskatchewan). IEEE Trans. Plasma Sci.; PS-4: No. 1, 69-71(Mar 1976).

The electromagnetic scattering from a bounded plasma column in a rectangular waveguide is investigated. Using image and boundary value techniques, equations are formulated for reflection, transmission and attenuation coefficients. Numerical results obtained from computations are in good agreement with results obtained using alternative formulations elsewhere.

28799 PROPAGATION AND DECAY OF ION ACOUSTIC WAVES IN THE PRESENCE OF ION-NEUTRAL COLLISIONS. Cussenot, J. R. (Nancy-1 Univ., 54 (France). Lab. de Physique des Milieux Ionises). Can. J. Phys.; 53: No. 13, 1256-1265(1 Jul 1975). (In French)

An experimental and theoretical study was made of the spatial propagation of ion waves in cesium plasma where ion-neutral collisions are important. Good agreement between theory and experiment is obtained.

28800 CALCULATION OF ABSORPTION COEFFICIENT OF LASER RADIATION IN A PARTLY IONIZED HYDROGEN PLASMA. Hudec, L. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). Fakulta Jaderna a Fysikalne Inzenyrska). Acta Polytech. (Prague), IV; No. 5, 139-144(1973). (In Slovak)

From 2nd scientific conference of the Czech Technical University; Prague, Czechoslovakia (12 Jun 1973).

The calculation is presented of the absorption coefficient of optical radiation having 10.6 μ (for a CO_2 laser) and 3.39 μ (for a He-Ne laser) wavelengths in a partially ionized hydrogen plasma for temperatures in a range of 10^3 to 10^5 K and for Ne densities ranging from 10^{12} to 10^{18} cm^{-3}. The calculation was made with a view to the application of lasers in the production, heating and diagnostics of plasma. Two absorption mechanisms are presumed, viz. the inversion brehmsstrahlung $e^- - H^+$ and the photoionization of neutral H atoms. The general system state is assumed.

28801 ON THE GENERATION OF SECONDARY D. C. FIELD QUANTITIES BY INTERACTING WAVES. Kildal, A. (Oslo Univ. (Norway). Fysisk Institutt). Beitr. Plasmaphys.; 14: No. 4, 121-133(1974).

In analogy with the phenomenon called acoustic streaming in ordinary fluid mechanics, the nonlinear effect generated by progressing waves in a multicomponent plasma is studied. Specifically, the dc streaming motion, electric field, and density generated by the waves was studied. The generation of second order effects in a rectangular wave-guide is also studied.

28802 SELF-ACTION OF ELECTROMAGNETIC WAVES IN A PLASMA UNDER MODULATION INSTABILITY. Litvak, A.G.; Mironov, V.A.; Fraĭman, G.M. (Radiophysics Research Institute). JETP Lett. 22: No. 7, 174-175 (5 Oct 1975).

It is shown that the development of modulation instability in the skin layer can lead to a bleaching of a dense opaque plasma under the influence of an intense electromagnetic wave. The characteristic parameters of the bleaching are determined. (auth)

28803 MAXIMA OF THE SCATTERING CROSS SECTION, THE WAVE VECTOR BEING QUASI ORTHOGONAL TO THE CONFINING MAGNETIC FIELD. Meyer, R. L. (Nancy-1 Univ., 54 (France). Lab. de Physique des Milieux Ionises). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 9, 125-127(1 Sep 1975). (In French).

The evolution of the scattering cross section maximas of an electromagnetic wave by a magnetoplasma, the angle between the wave vector and the confining magnetic field approaching $\pi/2$ were computed. It is shown that the maximas are shifted toward the roots of the electrostatic dispersion relation in perpendicular propagation. These roots are not exactly the electron cyclotron harmonics. (FR)

28804 PHENOMENOLOGICAL THEORY OF WAVE SCATTERING ON A TURBULENT PLASMA. Tyzhnenko, A.G.; Khizhnyak, N.A. (A. M. Gor'kii Khar'kov State University). Sov. Phys.—Tech. Phys. 20: No. 8, 1029-1033 (Aug 1975).

By describing turbulence in a plasma in terms of randomly distributed inhomogeneities whose electron density fluctuates with time, we can determine the permittivity. Using Maxwell's equation in integral form, we obtain the amplitudes of reflected and transmitted waves at the main frequency and at the combination frequencies. We determine the conditions for strong reflection at the combination frequencies in the presence of ordered wave perturbations in the plasma. (auth)

28805 ION-ACOUSTIC DISTORTION OF A MAGNETIC FIELD. Vainshtein, S.I. (Siberian Institute of Terrestrial Magnetism, the Ionosphere, and Radio Wave Propagation, Academy of Sciences of

the USSR, Irkutsk). Sov. Phys.—Tech. Phys. 20: No. 8, 1034-1039 (Aug 1975).

The interaction of ion-acoustic waves with a weak magnetic field is investigated. The electrons execute weak "electromagnetic" motion, and the nonlinear electron current has a component parallel to the magnetic field. This current can produce an intense and rapid rearrangement of the magnetic field. In particular, both rapidly growing and rapidly decaying solutions are found. In the former case the field energy is taken from the ion-acoustic energy; in the latter case the field energy is transferred to the ion-acoustic waves, eventually resulting in heating of the plasma. The behavior of perturbations against the background of a homogeneous field is analyzed. A criterion of validity of the theory and the field growth rate are discussed for space plasmas and laboratory plasmas. (auth)

28806 SEARCH FOR NONTHERMAL ELECTRON DENSITY FLUCTUATIONS BY LIGHT SCATTERING. Corkum, P.B.; Kronast, B.; Benesch, R. (Division of Physics, National Research Council of Canada, Ottawa, Canada). Phys. Rev. A 13: No. 4, 1557-1562 (Apr 1976).

Enhancements above the predicted spectrum for a thermal plasma have been reported at various multiples of 1/4 the plasma frequency in an $\alpha \lesssim 1$ plasma. We have investigated the spectrum of a θ-pinch plasma over the range of parameters covering reported deviations. With a 2-Å resolution we were able to fit thermal spectra to the observed spectra with a standard error of estimate, in most cases, of less than 2%. Using parameters very similar to those used in a recently published study where many deviations were reported, we were able to fit a thermal spectrum to our measured spectrum with a standard error of estimate of 4% and 0.66-Å resolution. (auth)

28807 NONLINEAR HARMONIC GENERATION OF ION-ACOUSTIC WAVES WITH DISPERSION. Buzzi, J.M.; Hirshfield, J.L. (Department of Engineering and Applied Science, Yale University, New Haven, Connecticut 06520). Phys. Fluids 19: No. 4, 554-556 (Apr 1976).

The observation of a dispersive effect on the nonlinear generation of ion-acoustic wave harmonics is reported. This effect is a spatial beat modulation of the second harmonic with a beating length L given by the dispersion: $L=2\pi/[K(2\omega)-2K(\omega)]$. (auth)

28808 ION-ACOUSTIC WAVES IN LARGE RADIO-FREQUENCY ELECTRIC FIELDS. Lee, A.; Jones, W.D.; Gleman, S.M.; Doucet, H.J. (Physics Department, University of South Florida, Tampa, Florida 33620). Phys. Fluids 19: No. 4, 557-560 (Apr 1976).

The propagation of ion-acoustic waves in high frequency fields is experimentally studied. The resulting phase-velocity decrease and enhanced damping are observed for radio-frequency field amplitudes up to $\alpha_e \simeq 0.5$, where $\alpha_e = eE/(m_e\omega_o\nu_c)$ is the normalized amplitude. Good agreement with the theory is found. (auth)

28809 OBSERVATIONS OF MAGNETOHYDRODYNAMIC RAREFACTION WAVES. Niimura, M. (Plasma Physics Laboratory, Columbia University, New York, New York 10027). Phys. Fluids 19: No. 4, 602-603 (Apr 1976).

Transverse magnetohydrodynamic rarefaction waves in a fully ionized deuterium plasma have been studied and measurements of the electron density as a function of time are compared with theoretical predictions. The agreement is good. (auth)

28810 INTERFERENCE STRUCTURE NEAR THE RESONANCE CONE. Singh, N. (Department of Electrical Engineering and Advanced Centre for Electronic Systems, Indian Institute of Technology, Kanpur 208016, India). Phys. Fluids 19: No. 4, 604-605 (Apr 1976).

By comparing theoretical and experimental results, the Airy function-like behavior of the interference structure near the resonance cone has been confirmed. This leads to a rigorous method for determining the resonance cone angle. (auth)

28811 EXCITATION OF LOWER HYBRID WAVES IN A PLASMA BY ELECTRON BEAMS. Papadopoulos, K.; Palmadesso, P. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Fluids 19: No. 4, 605-606 (Apr 1976).

The linear theory of excitation of electrostatic lower hybrid waves by electron beams is presented. The importance of such waves in tokamaks with runaway electrons is discussed. (auth)

28812 BEAM TRAPPING SUBSEQUENT TO THE PARAMETRIC PUMP DEPLETION SATURATION OF A BEAM-PLASMA INSTABILITY. Jones, R.; Carr, W.; Seidl, M. (Physics Department, Stevens Institute of Technology, Hoboken, New Jersey 07030). Phys. Fluids 19: No. 4, 607-608 (Apr 1976).

Large amplitude wave fields can stabilize by parametric decay, but the particle distribution that drives them cannot. In a beam-plasma system, it is shown that the beam traps in the potential of slower grown modes having phase velocity closer to the beam velocity. (auth)

28813 TRANSIENT RESPONSE FROM A SMALL ANTENNA IN AN ANISOTROPIC PLASMA. Simonutti, M.D. (California Institute of Technology, Pasadena, California 91125). Phys. Fluids 19: No. 4, 608-610 (Apr 1976).

The linear response of a cold anisotropic plasma to a point source under impulse excitation displays a frequency spectrum having maxima at the two frequencies determined by the resonance cone condition and at the upper hybrid frequency. A laboratory demonstration is reported. (auth)

28814 STIMULATED BRILLOUIN SCATTERING OF CO_2 LASER RADIATION FROM UNDERDENSE PLASMA. Offenberger, A.A.; Cervenan, M.R.; Yam, A.M.; Pasternak, A.W. (Department of Electrical Engineering, University of Alberta, Edmonton, Alberta, Canada). J. Appl. Phys. 47: No. 4, 1451-1458 (Apr 1976).

Results of detailed measurements undertaken to compare experiment and theory of stimulated Brillouin scattering of high-intensity CO_2 laser radiation from underdense hydrogen and helium plasmas are reported. Spectral measurements confirm the ion acoustic wave as responsible for the backscatter. Ion Landau damping and collisions both contribute to spectral broadening. The maximum linear scattering growth rate γ_k was determined experimentally to be 6×10^{11} sec^{-1} in good agreement with a theoretical value calculated from random-phase wave scattering. The value derived assuming coherent-wave interaction was 10^{11} sec^{-1} which is a factor of 2 greater than the corresponding theoretical prediction. Temporal characteristics and reflectivity of the backscattered radiation are discussed. (auth)

28815 SMALL-SCALE DENSITY FLUCTUATIONS IN THE ADIABATIC TOROIDAL COMPRESSOR. Mazzucato, E. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 36: No. 14, 792-794 (5 Apr 1976).

A new class of density fluctuations has been observed in the adiabatic toroidal compressor (ATC) tokamak by spectral analysis of scattered microwaves. The observed frequency spectrum is consistent with that of drift waves with amplitudes that are maximum in the wavelength range 0.5–1.0 cm where the transverse inertia of ions is important for plasma stability. The total density fluctuation is $\tilde{n}_e \gtrsim 5\times10^{-3}\bar{n}_e$. We estimate that these fluctuations could account for a large fraction of the electron energy losses of the ATC discharge. (auth)

28816 SHOCK WAVES GENERATED BY AN OSCILLATING ELECTRIC FIELD IN AN EXPANDING PLASMA. Ikezi, H. (Bell Laboratories, Murray Hill, New Jersey 07974); Mima, K.; Nishikawa, K.; Inutake, M. Phys. Rev. Lett. 36: No. 14, 794-797 (5 Apr 1976).

A strong radio-frequency field applied to an expanding plasma is found to produce a shock at the surface where the local plasma frequency matches the applied frequency. The shock propagates towards the upstream overdense region with the ion-acoustic speed relative to the plasma flow. The density jump at the shock front is found to be proportional to the field amplitude. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 28767, 29487, and 29488.

28817 PHOTOVOLTAIC PROPERTIES OF *n*-CdSe/*p*-ZnTe HETEROJUNCTIONS. Buch, F.; Fahrenbruch, A.L.; Bube, R.H. (Department of Materials Science and Engineering, Stanford University, Stanford, California 94305). Appl. Phys. Lett. 28: No. 10, 593-595 (15 May 1976).

Measurements of the diffusion potential, depletion layer width, and bias dependence of quantum efficiency for *n*-CdSe/*p*-ZnTe heterojunctions are used to construct a band diagram for the junction and to propose a current transport model. A new value of the electron affinity of CdSe is indicated by measurements of the open-circuit voltage at low temperatures and high intensities. The saturation current density J_0 is controlled by a thermal activation energy of 0.8 eV, corresponding to electron flow to the interface where recombination occurs through interface states. Performance as photovoltaic cells is limited by the short diffusion length of holes in CdSe. (auth)

Facilities and Equipment

Refer also to abstracts 30431, 32466, 32498, 32499, 32506, 32516, 32519, and 32520.

28818 (CEA-CONF-3148) MAINTENANCE OF ELECTRONIC EQUIPMENT AT THE SACLAY NUCLEAR RESEARCH CENTRE. Chicheportiche, A.; Raoult, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Services d'Electronique). Jun 1975. 14p. (In French). INIS.

From INOVA 75th meeting on maintenance; Paris, France (9 Jun 1975).

The Test-Repair Group of the Saclay Electronics Services ensures the maintenance of electronic equipment available to users of the Saclay site. The more and more frequent use of microelectronics in these instruments increases the electronic operator density and the working and data transmission sequences are becoming difficult to understand. This leads to complications in the adjustment, testing and repairs. Ways and means are studied to facilitate maintenance while reducing the immobilization time of the equipment and the repair costs. The Saclay Electronics Services have developed a method of systematic test sequence formulation and breakdown diagnosis based on the properties of binary analysis. This method is used by a supplier of the CEA which has built the corresponding test equipment. Owing to the test programmes established for each component of an apparatus it is possible for example to locate a faulty element on a plan including more than 100 integrated circuits and to replace it in no more than 10 minutes. (FR)

28819 (CEA-CONF-3204) HEAT TRANSFER IN HELICAL TUBE SODIUM HEATED STEAM GENERATORS. Duchatelle, L.; Nucheze, L. de; Robin, M. G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). 1975. 17p. INIS.

From international seminar on future energy production: heat and mass transfer problems; Dubrovnik, Yugoslavia (25 Aug 1975).

One of the key problems for the success of the fast breeder reactor is the development of a reliable sodium heated steam generator. For the 1200 MWe Super Phenix project, the CEA jointly with EDF, has carried out a research and development program for an helically coiled tube steam generator to be manufactured by the Fives-Cail Babcock Company. In the 5MW CEA test facility at Grand Quevilly an experimental program was performed in order to gain the basic knowledge on heat transfer and pressure drop for boiling water flowing in four helically coiled tubes heated by a counter flow liquid metal, which was badly needed for the design. A comparison between experimental results and predictions at various heat ratings shows a fair agreement and it is demonstrated that experimental results compare very well with computer code predictions for a 45 MWt mock-up simulating a liquid metal heated once-through steam generator, with 24 tubes arranged in three layers, which has been tested at the EDF Renardieres facility. All correlations used in our computer code are reported.

28820 (HEDL-SA-926) HYDRAULIC DESIGN CONSIDERATIONS FOR A MULTI-TUBE SODIUM ECONOMIZER. Hassberger, J. A.; McConnell, P. M.; Olson, W. H. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. 21p. (CONF-751101-69). Dep. NTIS $3.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Operating experience gained from tests shows that flow distribution effects can severely affect the thermal performance of high effectiveness, low pressure drop sodium heat exchangers. It has been shown that design efforts for such devices must include proper consideration of potential causes of flow maldistribution within the tube bundle. Furthermore, it has been demonstrated that fairly simple design features can be capable of eliminating detrimental flow fields in the tube bundle.

28821 (INIS-mf-1967, pp 45-53) METALLURGICAL FLOW RECOGNITION BY RANDOM SIGNAL ANALYSIS OF STRESS WAVE EMISSIONS. Woodward, B. 1973.

From conference on acoustic and vibration signal analysis; Sydney, Australia (6 Jul 1973).

In conference on acoustic and vibration signal analysis. (New South Wales Univ., Kensington (Australia). School of Physics).

The present study involves detailed random signal analysis of individual "bursts" of emission with objective of "reading" their frequency spectra to identify specific metallurgical mechanisms. Mild steel unnotched testpieces were used in the early stages of development of this research. From a fracture mechanics point of view this research could lead to a powerful nondestructive testing device allowing identification of interior, instead of only surface, deformation mechanisms. (auth)

28822 (ORNL-tr-4042(DRAFT)) 900- AND 1350-MW SECTIONS: RELIABILITY OF PRESTRESSED CONCRETE ENCLOSURES. Marcellin, J. P. 16 Apr 1975. Translated by M. Gerrard from French Report. 22p. Dep. NTIS $3.50.

On a world-wide scale, engineers have gone more and more to the use of prestressed concrete, which at present is considered the safest and most economic construction material. In France, for example, the proportion of prestressed concrete bridges has increased from 15 to 85 percent in the past 10 y. The nuclear industry—today in full effort—has largely used prestressed concrete as construction material for confinement vessels for light-water reactors. Concerned for the protection of the population and their installations, construction supervisors must decide what safety they can expect from engineering construction, the final barriers between the environment and a medium presenting a nuclear risk in the case of the reference accident. The purpose of the present study was to determine what could be expected in time from a confinement shell entirely from the viewpoint of the lasting capability of prestressed concrete material. It does not justify cases specific to nuclear projects.

28823 (SAND-76-6017) NUCLEAR FACILITIES, VALVES: MATERIALS, MANUFACTURE, TESTING. (DIN Deutsches Inst. fuer Normung e.V., Berlin (F. R. Germany)). Sep 1973. Translation by P. Newman of DIN-25418. 17p. Dep. NTIS $3.50.

The draft standard, whose content does not represent the final form of the standard and consequently is not meant for application, is presented to the public for testing and comments so that it can be improved as required. The standard was written in collaboration with the Pressure Vessel Study Group. Topics include range of validity, specification levels, materials, calculations, manufacture, tests, and markings. This standard is valid for valves in nuclear facilities, in particular nuclear power plants, research reactors, hot cells, fuel processing plants, facilities for reprocessing and storing of radioactive materials, fuel enrichment facilities, fuel element plants. (TFD)

28824 (UCRL-50016-75-3) MECHANICAL ENGINEERING DEPARTMENT. Quarterly Report, July–September 1975. Stone, R. G.; Barnett, J. M. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.) 30 Sep 1975. Contract W-7405-Eng-48. 26p.

Each of the five sections of the report was abstracted and indexed separately for ERA; two sections were abstracted for NSA. In addition the report contains four brief technical notes and abstracts of 13 UCID and UCRL reports. (EJH)

For abstracts of individual sections see: 28850 and 28851.

28825 THIN WINDOWS FOR GASEOUS AND LIQUID TARGETS: AN OPTIMIZATION PROCEDURE. Hassenzahl, W. V. (Los Alamos Scientific Lab., NM); Gray, W. H. Cryogenics; 15: No. 11, 627-638(Nov 1975).

Many nuclear physics experiments require cryogenic or high-pressure gas targets with thin windows. To obtain the best data,

that is, to reduce background signals, a target window would ideally have zero thickness and zero deflection. Since this is not possible a trade-off is made among target geometry, window geometry, window material, and window thickness. Measurements of deflections of a variety of window materials and geometries were performed at room temperature and in liquid nitrogen to aid window design in the future. A simple graphical method for predicting the rupture pressure for several typical window materials is described. The results of the deflection measurements are compared with a finite element computer program Membran which is used to predict window deflection and material stresses for a uniform applied pressure.

28826 STATUS OF NUCLEAR STANDARDS: PANEL DISCUSSION. Conf. Remote Syst. Technol., Proc.; 22: 97-100(1974).

From 22nd conference on remote systems technology; Washington, DC, USA (Oct 1974).

The four panelists who participated in the discussion presented introductory remarks concerning their views on the subject. Their remarks covered "the designer", "the builder", "the utility", and the AEC Regulator viewpoints. (TFD)

28827 SELF ADJUSTING ROTATING BODY. (to Philips Gloeilampenfabrieken, N.V.). Netherlands Patent 7,314,750/A/. 26 Oct 1973. 5p. (In Dutch).

A method is described to stabilize a rotating body by using a liquid of high viscosity giving an automatic negative feedback on side movements. Attention is paid to the heat transfer to the rotating body. (NL)

28828 AREA DISTORTION IN NARROW BEAM ROTATION RADIOGRAPHY. Saemfors, K. A.; Welander, U. (Centrallasarettet, Boden (Sweden)). Acta Radiol., Diagn.; 15: No. 6, 650-655 (1974).

An image exposed with rotating narrow beam methods is free from distortion at the center of the object plane which is depicted without blurring. Outside this object plane the magnification factor is different in the horizontal and vertical directions, causing distortion of the image and a variable magnification factor of an area. The variation of this magnification factor, in this report called area distortion, has been calculated mathematically. From the mathematical expressions functions have been obtained which are valid for the Orthopantomograph 3.

Lasers

Refer also to abstract 31160.

28829 (AD/A-005636) STUDY OF WATER ABSORPTION LINES IN THE NEAR INFRARED. Semiannual Technical Rpts. 2/3, 1 Nov 1973-31 Oct 1974. Javan, A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). 17 Feb 1975. Contract N00014-75-C-0300. 74p. NTIS $4.25.

Progress has been made in the following area: (1) development of a tunable 5 mu m spin-flip Raman laser and application to precision spectroscopy of H_2O; (2) studies of wings of water vapor lines; (3) other spectroscopic applications of the spin-flip Raman laser; (4) development of a tunable 5 mu m pulsed laser; (5) spectroscopy of D_2O using an acoustical modulator for frequency tuning; (6) velocity dependence of collision processes in NH_3; and (7) theoretical formulation of absorption far from line center-collision induced absorption in rare gas mixture.

28830 (AD/A-006646) PRODUCTION ENGINEERING MEASURE FOR OPTICAL PUMPS FOR LASERS. Quarterly Report No. 5, Jul-Sep 1974. Maynard, R.; Sowers, H. (ILC Technology, Inc., Sunnyvale, Calif. (USA)). Dec 1974. Contract DAAB05-73-C-2078. 37p. (R-ILC-73-22/Q5). NTIS $3.75.

See also quarterly rept. No. 4, AD/A-000903.

This program is directed toward establishing a capability for manufacturing flashlamps that are to be used as optical pumps for Nd:YAG laser systems. This report describes the work carried out during the fifth quarter of the program. The four synthetic fused quartz ETS lamps were life tested in the external trigger mode. The lamps exceeded the minimum laser efficiency requirement at the one million shot point when tested in the simmer mode, but the efficiency was marginal when operated in the external trigger mode. All ETS lamps tested passed the vibration and shock tests. All ETS lamps tested passed the laser output variation test at the one million shot point when operated in both the simmer mode and the external trigger mode. All ETS lamps passed the anti-coincidence pulse requirement at the one million shot point. (GRA)

28831 (AD/A-006671) LOW LOSS WINDOW MATERIALS FOR CHEMICAL LASERS. Semiannual Technical Report, 9 Jul 1974-9 Jan 1975. Harrington, J. A. (Alabama Univ., Huntsville (USA). Dept. of Physics). Jan 1975. Contract DAAH01-74-C-0437. 30p. (UAH-RR-166). NTIS $3.75.

See also report dated Jul 1974, AD-784326.

The increasing interest and importance of chemical lasers has led to a demand for further materials studies at DF and HF chemical laser frequencies. In order to meet this demand a small cw chemical laser has been built for calorimetric measurements of the absorption coefficient. A wide variety of low loss materials has been studied at DF (3.8 mu m) and HF (2.7 mu m) frequencies. In conjunction with the absorption measurements, chemical cleaning and polishing techniques have been developed and applied to some materials to determine their effectiveness in minimizing surface absorption. Calorimetric measurements of the optical absorption coefficient at chemical laser frequencies are reported on single and polycrystalline alkaline earth fluorides and alkali halides, single crystal magnesium oxide, sapphire, magnesium fluoride, strontium titanate, and other materials. Infrared spectrometer data on the absorption coefficient as a function of frequency for most of the materials studied are presented. As in past work, these data serve to indicate the value of the absorption coefficients expected in the HF-DF frequency regime. The infrared scans also reveal impurity structure in a few oxide materials in this same region.

28832 (AD/A-006978) DEVELOPMENT OF IR TRANSMITTING CHALCOGENIDE WINDOWS. Final Technical Report, 1 Apr 1972-30 Sep 1974. Moynihan, C. T.; Macedo, P. B.; Maklad, M. S.; Mohr, R. K.; Howard, R. E. (Catholic Univ. of America, Washington, D. C. Vitreous State Lab.). Feb 1975. Contract N00014-67-A-0377-0017. 38p. NTIS $3.75.

A quantitative study of infrared absorption in the 250 to 4000/cm region of As_2Se_3 glasses doped with small amounts of As_2O_3 or purified has been carried out with particular attention to absorption in the wavelength regions of the CO_2 and Co lasers. The dependence of the relative intensities of the oxide impurity bands in the 650 to 1340/cm region on the total amount of As_2O_3 added to the glass indicates the existence of three distinct oxide impurity species. A number of higher frequency impurity bands which are due to the presence of hydrogen in the glass and whose intensities are highly dependent on the glass melting conditions have been observed and classified. Intrinsic multiphonon absorption coefficients of mixed As_2S_3-$GeSe_2$ glasses were found to be of the same magnitude at the same respective frequencies as those for pure As_2Se_3 glass.

28833 (AD/A-007241) ENERGY TRANSFER PROCESSES IN MOLECULAR LASERS. Final Technical Report, 26 Jan 1971-30 Jun 1974. Fisher, E. R.; Abraham, G.; Lightman, A.; Morgan, L.; Yarema, S. (Wayne State Univ., Detroit, Mich. (USA). Research Inst. for Engineering Sciences). 6 Jan 1975. Contract DAHC04-74-G-0036. 126p. NTIS $5.75.

This final report details neutral energy transfer and molecular plasma models which have been developed. These numerical models are exercised on pulsed CO lasers both with and without gas additives. The important phenomenology operative in the CO laser is indicated. Experiments are also presented on the operating characteristics of a cw CO laser both with and without gas additives. These experimental measurements are discussed in the framework of the important plasma and neutral chemistry processes. Sections included are entitled: modeling of a pulsed CO/N_2 molecular laser system; effect of temperature and mixture components; and calculations on the electron energy distribution in a molecular laser plasma.

28834 (AD/A-007257) PRODUCTION ENGINEERING MEASURE FOR OPTICAL PUMPS FOR LASERS. Quarterly Report No. 6, Oct-Dec 1974. Maynard, R.; Oblanas, J. (ILC Technology, Inc., Sunnyvale, Calif. (USA)). 15 Jan 1975. Contract DAAB05-73-C-2078. 22p. (R-ILC-73-22). NTIS $3.25.

See also AD/A-006646.

This program is directed toward establishing a capability for manufacturing flashlamps that are to be used as optical pumps for laser systems. This report describes the work carried out during the sixth quarter of the program. Life tests were conducted on two lamps constructed with 1.0 mm thick walls of synthetic fused quartz. These lamps showed less degradation with life than did the second engineering test sample lamps constructed with 0.5 mm thick walls. Proposed changes to the lamp specification SCS-436A were recommended on the basis of lamp and test equipment data accumulated to date. The government furnished test laser was refurbished and the two government furnished life test vehicles were repaired.

28835 (AD/A-007577) MOLECULAR LASERS IN E-BEAM STABILIZED DISCHARGES. Final Report, 15 Mar 1972-30 Jun 1974. Byron, S. R.; Nelson, L. Y.; Fisher, C. H.; Mullaney,

G. J.; Pindroh, A. L. (Mathematical Sciences Northwest, Inc., Bellevue, Wash. (USA)). Feb 1975. Contract N00014-72-C-0430. 182p. (MSNW-75-105-4). NTIS $7.00.

See also report dated Aug 1974, AD/A-001062.

This report describes the results of a program directed toward the development of new lasers in the infrared and visible regions of the spectrum, utilizing electron-beam-stabilized electric discharge excitation. The first laboratory observations of laser emission from HF and DF excited directly by an electric discharge were made. The effectiveness of vibrational transfer from H_2 and D_2 to HF and DF, respectively, was verified. A quantitative model of the kinetics of the electric discharge and the vibrational populations of H_2 and HF was formulated for $Ar/H_2/HF$ mixtures. A model for long pulse visible laser emission from electronically excited molecules was formulated that involves rapid collisional quenching of the vibrational energy of the electronic states. The application of this approach to N_2 electric discharge lasers was explored through fluorescence emission studies. The effect of energy pooling was studied. The effect of various additives such as He, Ar, SF_6, and C_2H_6 on the populations of several vibrational levels of each of these excited states was investigated.

28836 (AD/A-007620) A TUNABLE DYE LASER DIAGNOSTIC FACILITY. Semiannual Technical Report No. 1, 24 Jun–24 Dec 1974. Connolly, J. I. Jr. (Science Applications, Inc., Arlington, Va. (USA)). 11 Feb 1975. Contract N00014-74-C-0394. 12p. (SAI-74-628-WA). NTIS $3.25.

The direct measurement of the fluorescent lifetimes of excited atomic and molecular species requires an excitation source of short duration compared to the lifetime of interest. In the case of allowed electronic transitions in metal halides, of interest as possible laser candidates, such lifetimes are typically tens of ns. Thus a laser pulse duration of less than 10 ns will be required. For maximum versatility, wavelength tunability over the visible spectrum is desired. These requirements are uniquely met by pulse laser-pumped dye laser systems. In this category are the following types: solid pulsed Nd:YAG laser, solid pulsed ruby laser, and pulsed gas N_2 laser. The N_2 gas pulsed laser was recommended for the laser induced fluorescence experiments.

28837 (AD/A-007977) DEVELOPMENT OF OPTIMIZED QUALITY BARIUM SODIUM NIOBATE CRYSTALS. Final Report, Nov 1973–Oct 1974. Rothrock, L. R.; Quandt, H. D. (Union Carbide Corp., San Diego, Calif. (USA). Crystal Products Dept.). Jan 1975. Contract F33615-74-C-1032. 53p. NTIS $4.25.

Barium sodium niobate ($Ba_2NaNb_5O_{15}$ or Banana) has been known for some years to be the most effective nonlinear optical material available for second harmonic generation. It has a large nonlinear electro-optic coefficient and a high optical damage threshold. Banana is a logical choice for use as a frequency doubler (1.06 to 0.53 mu m) for laser transmitters in such applications as space laser communications systems. However, Banana is an extremely difficult crystal to grow. The objective of this program was to improve growth techniques so that crystals of optimized quality could be produced. Barium sodium niobate crystals with high optical quality and low coefficient of absorption were developed. Characterization techniques applied to these crystals are described.

28838 (AD/A-008077) CHEMICAL LASER DILUENTS. Final Report, Jun 1974–Feb 1975. McDonald, J. K. (Athens Coll., Ala. (USA). Science Div.). Feb 1975. Contract DAAH01-74-C-0813. 13p. NTIS $3.25.

The purpose of this study was to monitor the effects of diluents on a HCl laser. The initial plans were to obtain a HCl laser with a mixture of helium, hydrogen, and chlorine, and then try other chemicals. However, it was found in the present study that no diluent enhanced the laser signal.

28839 (AD/A-008245) SYNCHRONIZATION OF NINE SOLID-STATE OPTICAL QUANTUM GENERATORS. Kugushev, A. M.; Golubeva, N. S.; Rozhdestvin, V. N. Translated from Izv. Vyssh. Uchebn, Zaved., Radioelektron.; 14: No. 4, 363-370 (1971). 14p. (FSTC-HT-23-0484-74). NTIS $3.25.

Questions for synchronizing solid-state lasers are studied. The transient process for a line of nine lasers to come into step, based on the quasi-classical theory of lasers is analyzed. Numerical analysis of the speed for synchronization, its dependence on the mutual misalignment of lasers, and the coupling coefficient and amplitude distribution of fields along the line was done on a computer.

28840 (AD/A-008255) TIMING OF LASER PULSES. Technical Report. Martignoni, P.; Ruge, H. C.; Cason, C. (Army Missile Research Development and Engineering Lab., Redstone Arsenal, Ala. (USA). Propulsion Directorate). 24 Feb 1975. 7p. (RK-TR-75-4). NTIS $3.25.

An electronic system to measure the laser pulse appearance delay time and pulse time width has been designed, assembled and tested. This electronic device may also be used with other systems. (GRA)

28841 (AD/A-008279) FIRST QUARTER FY75 APPLIED OPTICS RESEARCH REPORT. Quarterly Report, 1 Jul–30 Sep 1974. Franken, P. A. (Arizona Univ., Tucson (USA). Optical Sciences Center). Oct 1974. Contract F04695-67-C-0197. 68p. NTIS $4.25.

Results of work in mathematical optics, quantum optics, thermal expansion and dimensional stability and image processing are reported. Also included is a list of professional publications and activities of Optical Sciences Center personnel.

28842 (AD/A-008878) FREE ELECTRON LASER PROJECT. Final Report, 1 Oct 1975–30 Sep 1974. Schwettman, H. A.; Madey, J. M. J. (Stanford Univ., Calif. (USA). W. W. Hansen Labs. of Physics). 30 Sep 1974. Contract F44620-73-C-0017. 50p. NTIS $3.75.

Progress attained during the period on the Free Electron Laser Program is reported. The program entails evaluating the feasibility of a new technique for laser excitation leading to tunable, very high-powered lasers at frequency ranges between far infrared and soft x-ray. The technique involves a relativistic electron beam traveling through a transverse, static spatially periodic, magnetic field. The electron beam is supplied by the Stanford Superconducting Linear Accelerator. This report includes a general description of the program, a summary of the scientific background, descriptions of experimental facilities, results to date, and future research plans.

28843 (AD/A-008953) COLLISIONAL ENERGY TRANSFER AND TOPICS RELATED TO THE GAS LASER MECHANISM. Final Report, 1 Dec 1973–31 Dec 1974. Sharma, R.; Javan, A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). 10 Mar 1975. 6p. NTIS $3.25.

The work done represented important steps in the theory of energy transfer during molecular collisions and the theory of collision-induced absorption. Experimental work included measurement of the rates and temperature dependencies for near-resonant transfer processes in several systems. These results were explained by the appropriate theoretical methods using long-range multipolar interactions and the distorted-wave first-order Born approximation. Collision-induced absorption coefficients in rare gas mixtures were also calculated. Eight journal publications resulted from this research.

28844 (AD/A-009207) AMPHOTERIC DOPANTS IN THE ACTIVE REGION OF GaAs LASERS. Final Report. Ashley, K. L. (Southern Methodist Univ., Dallas, Tex. (USA). Dept. of Electrical Engineering). 15 May 1974. Contract DAAK02-73-C-0226. 15p. NTIS $3.25.

Double heterojunction lasers were fabricated with Ge and Si in the active region. Spontaneous diodes were fabricated with and without Si and diodes without Si exhibited a shorter wavelength spectral peak by about 9 MeV. Diodes with Te compensation were similar to diodes without compensation. The lasers had a characteristic spectral peak at approximately 9000 A. The best quantum efficiency (incremental) measured was approximately 22 percent (0.32 W/A). This form of doping in the active region appears to produce diodes which are very favorable with respect to threshold current. Towards the end of the activity a laser wafer was obtained with the same configuration except with Te in lieu of Si as the compensating impurity.

28845 (AD/A-009853) HF CHAIN REACTION LASER. Final Technical Report. Boedeker, L. R.; Verdieck, J. F.; Hall, R. J. (United Technologies Research Center, East Hartford, Conn. (USA)). May 1975. Contract N00014-74-C-0379. 60p. (R-75-951883-4). NTIS $4.25.

The report describes a thermally initiated H_2/F_2 flow tube reactor experimental program to provide clearly defined experimental results via emission spectroscopy diagnostics on vibrational population levels attained in the cw H_2/F_2 chain reaction for comparison with theory. Highly dilute, subsonic, near room temperature reaction conditions in the 1 to 10 torr pressure region have been studied which result in development of the chain over flow tube distances of about 1 meter, much larger than mixing length. An examination of the dominant kinetics was conducted via the accumulation of spectral and uv data over a range of key experimental parameters including distance from the H_2 injector, x; H_2 flow; F_2 flow pressure; dissociator temperature, and O_2 additive flow. Overtone spectra were obtained. The experimental results from the flow tube on high lying vibrational population distributions observed at 5 torr have been compared with predictions of the 1-D scheduled mixing analytical model in a manner

which attempts to identify potential key areas of kinetic uncertainty with the chain.

28846 (AD/A-009854) INVESTIGATION OF A COMBUSTION-DRIVEN CHAIN-REACTION HCl LASER. Final Technical Report. Meinzer, R. A.; Hall, R. J. (United Technologies Research Center, East Hartford, Conn. (USA)). May 1975. Contract N00014-74-C-0377. 161p. (R-75-951895-4). NTIS $6.25.

A cw combustion-driven HCl laser based on a H_2-ClF chain-reaction was investigated and found to possess attractive characteristics for high power laser operation. Under some operating conditions, this laser simultaneously operates at HCl and HF wavelengths. The maximum power extracted at HCl wavelengths was 300 W. A variety of operating conditions were evaluated and the results suggest that the optimum performance was obtained with a combustor gas temperature of approx. 1000°K. Chemiluminescent emission spectroscopy measurements performed on the active media indicated that total vibrational population inversions were achieved on both HF and HCl transitions. An iterative comparison was made from which limits were established for mixing rates and for a number of important reactions for which neither rate data nor product distributions existed. With this tuned computer model, the HCl laser is predicted to operate at static pressures in excess of 50 torr so that pressure recovery directly to atmosphere may be possible.

28847 (AD/A-009895) PREPARATION AND SINGLE CRYSTAL GROWTH OF $YLiF_4$ LASER MATERIALS. Final Report, 1 Jan-31 Oct 1974. Uhrin, R.; Belt, R. F.; Puttbach, R. C. (Litton Systems, Inc., Morris Plains, N. J. (USA). Airtron Div.). Jan 1975. Contract N00014-70-C-0379. 56p. NTIS $4.25.

See also report dated Feb 1974, AD-775211.

This report describes fluoride preparation and single crystal growth of the solid state crystal laser of composition Y(.45)Er (.499) Tm(.05)Ho(.001)LiF4. The respective component fluorides were prepared from oxides by hydrofluorination at 800 to 1200°C in a platinum reactor. Single crystal growth was performed by a seeded-solution method utilizing platinum apparatus under a N_2-HF atmosphere. Techniques were developed for core drilling and fabricating (3 x 30 mm) or (3 x 50 mm) a-axis cylindrical rods. Passive optical tests have demonstrated high quality and freedom from scattering sites. Infrared analyses on 5 to 10 cm paths have shown low ppM trace molecular impurities. Active laser tests in long pulse and Q-switch operation are not completed but preliminary data indicate threshold above 10 J due to compositional effects.

28848 (COM-75-10135) OPTICAL MATERIALS CHARACTERIZATION. Semiannual Technical Report, 1 Jul-31 Dec 1974. Feldman, A.; Horowitz, D.; Waxler, R. M.; Malitson, I.; Dodge, M. J. (National Bureau of Standards, Boulder, Colo. (USA), Inst. for Basic Standards). Jan 1975. 18p. (NBSIR-75-639). NTIS $3.25.

See also report dated Jul 1974, AD-782564.

The authors have measured the following parameters of chemical vapor deposited polycrystalline ZnSe (CVD ZnSe): refractive index and change of index of refraction with temperature (dn/dT) over the wavelength range 0.5 micrometers to 18 micrometers using the method of minimum deviation; the coefficient of linear thermal expansion and dn/dT at 10.6 mu m using Fizeau interferometry; and the elastic moduli and photoelastic moduli using Fizeau and Twyman-Green interferometry. A sensitive technique has been developed for measuring stress-optical constants of materials that exhibit a small stress-optical effect. (GRA)

28849 (COM-75-50112) ANALYSIS OF OPTICALLY EXCITED MERCURY MOLECULES. Final Report. Drullinger, R. E.; Hessel, M. M.; Smith, E. W. (National Bureau of Standards, Boulder, Colo. (USA)). Jan 1975. 53p. (NBS-MN-143). Paper copy available from GPO as C13,44:143.

Sponsored in part by Advanced Research Projects Agency, Arlington, Va. and Los Alamos Scientific Lab., N. Mex.

The Hg_2 molecule is representative of a class of molecules which have dissociative ground states and bound excited states. It can therefore be used as a prototype of this class of molecules which are of interest as potential new laser candidates. Because of the non-bound ground state, standard absorption spectroscopic techniques cannot be used to obtain the necessary information about the excited states. The authors have therefore developed new measurement techniques to obtain potential curves, f-values, and kinetic behavior for Hg_2. These techniques are applicable to this whole class of dissociation molecular systems.

28850 (UCRL-50016-75-3, pp 10-13) TESTS OF ELLIPSOIDAL MIRRORS. 30 Sep 1975.

In mechanical engineering department. Quarterly Report, July–September 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Optical tests were completed on three 300-mm-diam, diamond-turned ellipsoidal mirrors. Similar mirrors will be used in focusing energy onto a pellet target in the laser fusion effort. For focusing energy, the geometrical figure of these mirrors is adequate; waviness is the limiting factor.

28851 (UCRL-50016-75-3, pp 14-15) LASER DAMAGE OF DIAMOND-TURNED AND POLISHED METAL MIRRORS. 30 Sep 1975.

In mechanical engineering department. Quarterly report, July–September 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Laser damage in diamond-turned and polished silver and copper mirrors was studied. Diamond-turned silver was found to have the highest laser-damage thresholds, and to compete favorably with dielectric mirrors.

28852 RELATION BETWEEN LASER CHARACTERISTICS AND Nd ION CONCENTRATION IN Nd : YAG CRYSTALS. Nishimura, T.; Omi, T. (Tokyo Shibaura Electric Co., Ltd., Horikawacho, Japan). Jpn. J. Appl. Phys.; 14: 1011-1016(Jul 1975).

Experimental results are reported for the relation between cw laser characteristics and the Nd ion concentration in Nd : YAG single crystals. The lasers studied are pumped by W-I or Kr arc lamps and equipped with single or double elliptical cavities. The equilibrium distribution coefficient of the Nd ion is determined in the pulling-grown Nd : YAG crystals to be 0.151 from the Nd ion concentration by x-ray fluorescence analyses. The slope efficiency and the inverse of the effective lamp input power at the threshold of the Nd : YAG laser are found to be proportional to the Nd ion concentration. Under high lamp input power, however, saturation of the laser output is observed for crystals with Nd ions constituting more than 1.0 at.% because of the large positive lens effect of the pumped rod.

28853 STUDIES OF A TEA CO_2 LASER WITH A CYLINDRICAL MIRROR UNSTABLE RESONATOR. Dyer, P. E.; James, D. J. (Hull Univ., Eng.). Opt. Commun.; 15: 20-25(Sep 1975).

Results of a study of a TEA CO_2 laser using a strip cylindrical unstable resonator which produces an output beam with suitable characteristics for producing a high quality line focus are described. Using this technique an irradiance of approximately 1 GW/cm^2 over a 5 cm long line focus has been achieved.

28854 MATERIALS FOR LIGHT EMITTING DIODES AND LASERS. Ellis, B. (Royal Aircraft Establishment, Farnborough, Eng.). Infrared Phys.; 15: 211-219(Sep 1975).

Electroluminescence has now been observed from 0.4 to 34 μ. An account of the materials used for luminescent devices is presented, with emphasis upon recent developments.

28855 GAIN MEASUREMENTS IN A TRANSVERSE-FLOWING $Na-N_2O$ + CO CHEMICAL LASER. Benson, R. C.; Bargeron, C. B.; Walker, R. E. (Johns Hopkins Univ., Silver Spring, MD). Chem. Phys. Lett.; 35: 161-166(1 Sep 1975).

N_2O laser gain profiles in a low-pressure Na-catalyzed N_2O-CO transverse-flow chemical laser have been measured for a variety of flow conditions. The small-signal gain depends on the CO/N_2O ratio with a maximum of about 0.005/cm measured to date. Analysis of emission spectra and computer modeling of the gain profiles indicate that 15 to 20% of the chemical energy is available for laser pumping, yielding a specific laser energy of ~210 J/mole of mixture.

28856 COMPETITION BETWEEN POLARIZATIONS IN A GAS LASER WITH A WEAK PHASE ANISOTROPY OF THE RESONATOR. Lipatov, A.S.; Parygin, V.N. (M. V. Lomonosov State University, Moscow). Sov. J. Quantum Electron. 5: No. 12, 1400-1403 (Dec 1975).

An investigation was made of the influence of fluctuations on the nature of the polarization of the radiation emitted from a gas laser with a weak internal anisotropy in the resonator. It was found that the minimum anisotropy at which the polarization became linear was governed by natural fluctuations in the active medium. (auth)

28857 CALCULATION OF THE ENERGY CHARACTERISTICS OF AN ELECTRIC-DISCHARGE CO_2 LASER. Vednov, A.A.; Vitshas, A.F.; Napartovich, A.P.; Panchenko, V.P. Sov. J. Quantum Electron. 5: No. 12, 1404-1408 (Dec 1975).

A model is proposed for the calculation of the output power of a fast-flow electric-discharge CO_2 laser. The model can be applied to various laser systems (with self-sustaining and non-self-sustaining discharges, with addition of CO_2 after passing through the discharge zone and without such addition). Quasi-one-dimensional equations of

gasdynamics are solved numerically together with equations of vibrational kinetics and allowance is made for the electrical excitation and stimulated transitions. An example of a calculation dealing with a CO_2+N_2+He laser is given. (auth)

28858 INFLUENCE OF WATER VAPOR ON THE GAIN OF A GASDYNAMIC N_2O LASER. Biryukov, A.S.; Volkov, A.Y.; Demin, A.I.; Kudryavtsev, E.M.; Kulagin, Y.A.; Sobolev, N.N. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 12, 1408-1412 (Dec 1975).

Theoretical and experimental investigations were made of the influence of water vapor on the gain of a gasdynamic N_2O laser. The results of measurements were in good agreement with the calculations. In contrast to a CO_2 laser, a considerable gain was obtained in a binary N_2O-N_2 mixture. The addition of a small amount of water vapor to this mixture had practically no effect on the gain. The value of the gain was fairly constant (of the order of 0.5×10^{-2} cm^{-1}) in a wide range of temperatures (1100–1700°K) and pressures (20–60 atm). (auth)

28859 PARAMETRIC INVESTIGATION OF A PULSE PHOTOINITIATED CHEMICAL CS_2-O_2 LASER. Gordon, E.B.; Moskvin, Y.L.; Pavlenko, V.S. (Institute of Chemical Physics, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 5: No. 12, 1422-1424 (Dec 1975).

The effective energy characteristics of a pulse photoinitiated CS_2-O_2 laser (the radiating molecule was CO) were determined by altering the active losses in the resonator and by amplifying superluminescence. The effective gain of a $CS_2 : O_2 N_2 O = 1 : 19 : 5$ mixture supplied with a photoinitation energy of 2.2 kJ was measured by both methods and found to be $(21\pm1)\times10^{-3}$ cm^{-1}. The active losses method was used to find the total internal losses, energy stored by population inversion, and resonator parameters optimal from the point of view of energy extraction. The superluminescence method was used to find the dependence of the gain on the pressure and composition of the mixture. The results obtained were used in a qualitative description of the CO laser on the basis of a two-level model. (auth)

28860 MEASUREMENT OF THE FREQUENCY OF THE *P*14 (10.6 μ) CO_2 LASER LINE. Domnin, Y.S.; Tatarenkov, V.M.; Shumyatskii, P.S. (All-Union Scientific-Research Institute of Physicotechnical and Radio Engineering Measurements, Moscow). Sov. J. Quantum Electron. 5: No. 12, 1426-1427 (Dec 1975).

The CO_2 laser emission frequency was measured by coincidence with the eighth harmonic of a D_2O laser (first harmonic at 84 μ). The results were used as the basis of a proposed system for measuring the frequency of a highly stable helium-neon quantum oscillator including a methane absorption cell and a D_2O laser. (auth)

28861 COMPACT DYE LASER WITH A NARROW CONTINUOUSLY TUNABLE EMISSION LINE. Rubinov, A.N.; Korda, I.M. (Institute of Physics, Academy of Sciences of the Belorussian SSR, Minsk). Sov. J. Quantum Electron. 5: No. 12, 1436-1437 (Dec 1975).

A description is given of an organic dye laser emitting one longitudinal mode ~0.3 nm wide. This laser is continuously tunable within the gain band of the active substance and the tuning can be performed without additional selective elements. The dye solution is in contact with the resonator mirrors. (auth)

28862 DYE-LASER FLUORESCENCE OF 4-METHYLUMBELLIFERONE AND RELATED COUMARINS. Haydon, S. C. (Univ. of New England, Armidale, New South Wales). Spectrosc. Lett.; 8: No. 11, 815-892(1975).

A detailed review of the lasing properties of the coumarin family of dye solutions is presented. (TFD)

28863 INGOT-NUCLEATED Pb/sub 1-x/Sn/sub x/Te DIODE LASERS. Lo, W.; Montgomery, G. P. Jr.; Swets, D. E. (General Motors Corp., Warren, MI). J. Appl. Phys.; 47: No. 1, 267-271(Jan 1976).

Large high-quality Pb/sub 1-x/Sn/sub x/ Te single crystals (x equals 0.13) have been grown by a horizontal vapor-growth process in which the horizontal temperature gradient is adjusted to produce nucleation on the source ingot. The crystals are free of metallic inclusions, low-angle grain boundaries and voids, and have bulk dislocation densities as low as 2 x $10^4/cm^2$. Diode lasers having up to 400-mu W single-mode cw power near 10.6 mu m have been fabricated from these crystals. Material quality, particularly dislocation density, appears to be the major factor governing device performance.

28864 PULSED $D_2 + F_2 + CO_2$ + He CHEMICAL LASER. Basov, N. G.; Zavorotnyi, S. I.; Markin, E. P.; Nikitin, A. I.; Oraevskii, A. N.; Borovich, B. L.; Grigor'ev, P. G.; Zuev, V. S. Sov. J. Quant. Electron. (Engl. Transl.); 4: No. 3, 311-313(Sep 1974).

A $D_2 + F_2 + CO_2$ + He pulsed chemical laser is put into operation at nearly atmospheric pressures in the mixture. The principal characteristics of the laser are the energy per pulse approximately equals 5J, specific energy yield 1.2×10^{-2} J/cm^3, and pulse duration approximately equals 10 μs. It is found experimentally that the CO_2 molecules inhibit the branched-chain self-ignition process. The use of photoinitiating components increases the utilization efficiency of the laser. (auth)

28865 SINGLE-FREQUENCY RUBY LASER WITH A SPATIALLY HOMOGENEOUS RADIATION FIELD AND VARIABLE DURATION OF NANOSECOND PULSES. Danileiko, Yu. K.; Manenkov, A. A.; Nechitailo, V. S. Sov. J. Quant. Electron. (Engl. Transl.); 4: No. 3, 336-338(Sep 1974).

The paper reports an investigation of a different method of generating a spatially homogeneous radiation field equivalent to the field of a single-mode laser. In this method the radiation is filtered outside the resonator by diffracting it in a system of apertures. The method is very efficient and it is not sensitive to the optical inhomogeneity of active elements or to the pumping conditions. (auth)

28866 AUTONOMOUS FEED CIRCUIT FOR A PULSED SOLID-STATE LASER. Dubinker, A. S.; Nilov, E. V. Prib. Tekh. Eksp.; 164-165(1975). (In Russian)

The feed circuit of a pulsed solid-state laser from a low-voltage primary source—a storage battery is described. The circuit is based on the principle of time compression of current pulses with simultaneous increase in voltage with the aid of nonlinear magnetic elements. The efficiency of the circuit can be made not lower than 0.5.

28867 EFFECTIVE LIFETIME OF THE CO_2 LOWER LASER LEVEL (10^00) IN PRESENCE OF ORGANIC ADMIXTURES. Atanassov, P. A. (Inst. of Electronics, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 10, 1355-1358(1975).

The effect of organic admixtures, in particular, chloroform and diethylether, on the output power and the plasma of CO_2 lasers was previously investigated. An increasing of the output laser power by a factor of 2.5 and 2 in the presence of $CHCl_3$ and $(C_2H_5)_2O$, respectively, was shown experimentally and a hypothesis on the mechanism of their action was put forward. Furthermore, the plasma in the laser was investigated. The maximum of electron energy distribution shifts towards the lower energies and, on the basis of these results, the excitation rates of the $CO_2(00°1)$ upper laser level were determined theoretically. The purpose of this work is to show the effect of chloroform and diethylether on the lower laser level of $CO_2(10°0)$ and to theoretically determine its effective lifetime in presence of organic admixtures and hence also of (a) the complex of the first vibrational levels of the deformational and symmetric vibrational modes of $CHCl_3$, and (b) of the first level of the antisymmetric mode of $(C_2H_5)_2O$.

28868 NUMERICAL STUDIES OF THE INTERPLAY BETWEEN SELF-PHASE MODULATION AND DISPERSION FOR INTENSE PLANE-WAVE LASER PULSES. Fisher, R. A. (Los Alamos Scientific Lab., NM). J. Appl. Phys.; 46: No. 11, 4921-4934(Nov 1975).

A computer algorithm is presented which allows simultaneous consideration of self-phase modulation and dispersion for predicting temporal shape changes during the propagation of plane-wave intense light pulses. The algorithm entails considering propagation alternately in regions where only one of the two above effects is operative. Numerical simulations of propagation in CS_2 indicate that, after sufficient travel, a shock can form on the leading edge of a mathematically smooth incident pulse. With further propagation, the entire pulse develops violent amplitude features. Impressed amplitude noise on the pulse is shown to intensify this instability. Propagation of 5-ps mode-locked dye laser pulses in CS_2-filled fibers is also considered. Shocks appear at 2-m propagation if the input peak intensity is 50 MW/cm^2. Furthermore, attenuation present in the fibers tends to stabilize the shape of the shock as it forms. For optimal compression more dispersive delay is required in a compressor than would have been needed in the absence of CS_2 dispersion. Compression of pulses emanating from the CS_2-filled fibers was also calculated. The subsequent compressed pulses are not much shorter than the temporal shock which had formed on the pulse prior to compression. Propagation distances in such experiments should thus be kept below the shock distance. The simulation of pulse propagation in Nd:glass laser amplifier chains is also studied, with nonlinearity and dispersion taken into account. In the absence of gain, pulses temporally broaden and flatten because the glass dispersion is the wrong sign to compress the chirp which develops at the temporal center of the pulse. In pumped amplifiers a sharp temporal spike forms at the center because the chirp swings the pulse center frequency through the center frequency of the amplifying transition at that time. It is demonstrated that under typical operating conditions, pulses are relatively stable to amplitude modulation.

28869 MANUFACTURE OF LASER GLASS. Oldfield, L. F. (to General Electric Co., Ltd.). US Patent 3,929,440. 30 Dec 1975. Priority date 30 Nov 1973, United Kingdom of Great Britain and Northern Ireland (UK). 8p.

The process for the manufacture of laser glass free from heterogeneities, such as platinum speck and gas bubbles, which tend to promote laser-induced damage in the glass laser rods, is described. The method consists of melting the glass-forming batch in a vessel of platinum or a platinum-based noble metal alloy, bubbling helium gas through the melt to remove bubbles of gas formed during the batch reaction, and refining the melt in the presence of a stream of dry oxygen-free rare gas, preferably argon, flowing over the surface of the melt. These steps are preferably carried out at a constant temperature, for example 1350 to 1450°C for a preferred class of glasses, consisting of (by weight) 53 to 60 percent SiO_2, 11.5 to 13.5 percent Li_2O, 22 to 24 percent SrO, 0 to 4 percent Al_2O_3, 2.5 to 6.5 percent Nd_2O_3, optionally 0.5 to 1.5 percent TiO_2 and 0 to 0.1 percent CeO_2 as solarization inhibitors, and optionally a small amount of a sensitizer. The refined melt is cast in a preheated mould, and the glass is annealed by cooling slowly from the upper annealing temperature.

28870 CARBON DIOXIDE GAS LASER WITH NUCLEAR PUMPING. Pustovalov, A. A.; Smirnov, B. M. Dokl. Akad. Nauk SSSR; 222: 583-586(21 May 1975). (In Russian).

Calculation of the parameters of a laser consisting of a tube filled with a mixture of helium, nitrogen, and CO_2, and excited by a radioactive material covering the walls of the tube is presented. Vibrational excitation of the molecules, raising them to the upper lasing level, takes place via secondary electrons created by ionization of the gas molecules by nuclear particles. The gas-filled tube has additional gratings. When fast electrons are scattered on these gratings, their energy is converted into that of slow electrons as a result of secondary emission. Since the power of the radioactive source is low, the analysis concentrates on the gain factor of the working mixture. Optimal concentrations of the gas components are calculated.

28871 OBTAINING LASER RADIATION WITH TWO-FREQUENCY MODULATION OF LOSS LEVEL. Tsikunov, V. N. Dokl. Akad. Nauk SSSR; 223: 328-331(11 Jul 1975). (In Russian).

The behavior of a solid-state laser for the case when the level of the losses varies under the effect of two harmonic disturbances of different frequency is analyzed. Analysis was carried out on the assumption of a homogeneous electromagnetic field in a self-excitation approximation and on the basis of an equation describing the time variation of the number of photons in the resonator under conditions of varying loss level. The behavior of the resonance shift for various relative values of the amplitudes and frequencies of the two harmonic modulations is studied. It is found that forced modulation can change, within wide limits, the sensitivity of laser systems to harmonic disturbances of another frequency. A forced periodic modulation with a certain frequency can shift the resonance frequency to higher frequency. This can be used to lead the resonance frequency out of the frequency band of parasitic disturbances, thereby reducing to a minimum their effect on the time changes of the intensity.

28872 HIGH-PRESSURE ELECTRIC-DISCHARGE CO_2 LASER. Ishchenko, V. N.; Lisitsyn, V. N.; Safronov, V. P.; Sorokin, A. R. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Kvantovaya Elektron. (Moscow); 2: 1374-1378(Jul 1975). (In Russian).

Investigations are reported on an electric-discharge CO_2 laser with a volume preionization by an auxiliary discharge through the dielectric and a low-resistance supply circuit for the main discharge. Lasing was achieved at a mixture pressure up to 13 atm. A dependence was found for the spectral composition and the radiation spiking behavior on the mixture pressure and content. The possibility of developing a continuously tunable laser and high-power lasers based on the suggested technique is discussed.

28873 CONTROL OF EMISSION DIVERGENCE IN SUPERRADIANT LASERS. Ishchenko, V. N.; Lisitsyn, V. N.; Starinskii, V. N. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Kvantovaya Elektron. (Moscow); 2: 1570-1572(Jul 1975). (In Russian).

Two techniques are proposed for controlling the divergence of the emitted beam of a superradiant N_2 laser operating in the ultraviolet range. The emission divergence is determined by the geometry of the discharge space and amounts to about 1°. The first technique employs a set of 7 grating diaphragms arranged perpendicular to the propagation of light in the discharge space 6 × 30 × 300 mm in size. The second technique employs a telescopic resonator made of cofocal mirrors. The effects of these techniques on the spatial characteristics of the laser output are evaluated.

28874 THEORETICAL STUDY OF THE VIBRATIONAL RELAXATION OF CO_2 MOLECULES IN MIXTURES CONTAINING CARBON OXIDE. Diakov, A. S.; Piskunov, A. K.; Cherkasov, E. M. (Moscow Physical-Technical Inst.). Kvantovaya Elektron. (Moscow); 2: 1419-1422(Jul 1975). (In Russian).

A theoretical study was made of the vibrational relaxation in a nonequilibrium flow of a gasdynamic laser utilizing CO + CO_2 + N_2 + H_2O mixtures. A dependence was derived for the inversion at the 00 deg 1 to 10 deg 0 transition of the CO_2 molecule on the concentration of CO molecules. It is shown that under certain conditions a gas dynamic laser may be developed which emits due to transitions in CO_2 and utilizes mixtures which do not contain nitrogen.

28875 GASDYNAMIC LASERS WITH OPTICAL PUMPING. Shmelev, V. M.; Margolin, A. D. (Inst. of Chemical Physics, Moscow). Kvantovaya Elektron. (Moscow); 2: 1445-1448(Jul 1975). (In Russian).

Theoretical considerations concerning the use of optical pumping in gasdynamic lasers are presented. It is shown that optical pumping can be achieved by using another laser or the same laser with optical feedback. Optical pumping is shown to increase the gain of the medium and to decrease the expansion of the gas in the nozzle of a gasdynamic laser.

28876 GAIN IN A MIXTURE OF ISOTOPIC CO_2 MOLECULES DURING PUMPING BY CO_2 LASER RADIATION. Golger, A. L.; Letokhov, V. S. (Inst. of Spectroscopy, Moscow). Kvantovaya Elektron. (Moscow); 2: 1508-1518(Jul 1975). (In Russian).

The possibility is discussed of building an infrared tunable gas laser based on the resonant optical pumping of a mixture of isotopic molecules by laser radiation. It is shown that the optical pumping system under consideration makes it feasible to develop a simple sealed-off laser. Gain is computed in binary and ternary mixtures of isotopic CO_2 molecules during optical pumping by CO_2–N_2–He laser radiation at a wavelength of 9.6 μ. It is shown that during optical pumping of the isotopic mixture of CO_2 molecules at a pressure of 1 atm and temperature of 400°K, a gain as high as 0.002/cm may be achieved both for pulsed and steady-state operation conditions. Under pulsed conditions, the required pumping energy density is 10J/cm^2. Under steady-state conditions, the same gain may be achieved using waveguide resonators of the order of 100 μ in dia with pumping power twice as high as its threshold value, equal to about 70 W.

28877 MULTIFACTOR OPTIMIZATION OF THE GASDYNAMIC CARBON DIOXIDE LASER. I. Gain Optimization. Losev, S. A.; Makarov, V. N. (Moscow State Univ.). Kvantovaya Elektron. (Moscow); 2: 1454-1458(Jul 1975). (In Russian).

A variational problem concerning the determination of optimal operating conditions for the gas-dynamic carbon dioxide laser is solved in order to obtain maximum gain values for the P20 (001)-(100) transition for nozzles of an arbitrary shape. The results are compared with optimization results for plane V-shaped nozzles. Optimal initial conditions (temperature, pressure, content) are found as well as the nozzle contour for mixtures of carbon dioxide with nitrogen and helium. Continuous increase in gain with pressure build-up is noted under optimal operating conditions.

28878 GASDYNAMIC PHOTORECOMBINATION LASERS. Kochelap, V. A.; Kukibnyi, Yu. A. (Semiconductor Inst., Kiev). Kvantovaya Elektron. (Moscow); 2: 1471-1480(Jul 1975). (In Russian)

A quantitative analysis of some operational aspects of gasdynamic electron-phototransition lasers is carried out making use of calculations of the flow of a recombinating gas in a supersonic nozzle. Such factors as nonequilibrium dissociation, inversion criteria, and the energy stored in the inverted states are studied as a function of the initial conditions, the nozzle configuration, and other factors.

28879 COMPARATIVE NOISE CHARACTERISTICS OF LASERS OPERATING AT 0.63 AND 1.15 MICRON WAVELENGTHS. Mazan'ko, I. P.; Molchanov, M. I.; Yaroshenko, N. G. Radiotekh. Elektron.; 20: 1301-1304(Jun 1975). (In Russian)

The influence of the regular oscillations of a gas-discharge plasma and its low-frequency noise on the emission of 0.63-micron and 1.15-micron helium-neon lasers was studied and compared. The amplitude spectra of the lasers and the discharge current spectrum are presented and discussed. The beam modulation factors of each laser and of the discharge current are tabulated.

28880 INTERNAL MODULATION OF POLARIZATION IN A GAS LASER. Parygin, V. N.; Lipatov, A. S. Radiotekh. Elektron.; 20: 1216-1224(Jun 1975). (In Russian)

A method is proposed for controlling the polarization of a single-mode gas laser by changing the direction of the resonator's

internal anisotropy. The frequency characteristics of laser emission are calculated theoretically for the case of a periodic change in internal anisotropy. It is shown that in a wide frequency range, the laser may produce emission whose plane of polarization will rotate with a frequency equal to one half the external pumping frequency.

28881 ALIGNMENT OF ATOMIC STATES BY A LASER-RADIATION FIELD AND ITS INFLUENCE ON LASER PROPERTIES. Voitovich, A. P.; Shkadarevich, A. P. Opt. Spektrosk.; 38: 1176-1181(Jun 1975). (In Russian)

It is shown that magnetic-field disruption of atomic-state alignment resulting from laser emission has a dominant effect on the lasing power of a He-Ne laser with an applied weak transverse magnetic field. Gap separation in the velocity distribution of the perturbed atoms is shown to have an insignificant part in this process, although its influence on the magnetic-field dependence of lasing power can be increased by using nonlinear effects similar to transition competition. The influence of gap separation on this lasing-power dependence is demonstrated experimentally in a laser having a resonator with isotropic polarization. It is shown that alignment decisively affects emission polarization and causes the emission in all modes to be polarized equally in a laser with a nonlinearly absorbing element and a resonator having isotropic polarization.

28882 NARROW RESONANCES IN A GAS LASER IN THE TWO-FREQUENCY GENERATION MODE. Bagaev, S. N.; Dmitriev, A. K.; Chebotaev, V. P. Opt. Spektrosk.; No. 3, 531-538 (1974). (In Russian)

This is a report of observed narrow resonances occurring in symmetrically placed longitudinal types of oscillation and of investigations into the frequency stability in two-frequency laser oscillation. The experimental equipment by which the discovery was made is explained and a diagram of it is given. Three lasers are involved, two filled with methane, the third with He-Ne. Results of the experiments are discussed and the form of the narrow resonances briefly analyzed. An expression is found for the oscillation power in terms of the frequency of one of the waves by assuming the saturation to be low.

28883 SPECTRUM OF LIGHT PULSES OF SUBNANOSECOND DURATION. Kryzhanovskii, V. I.; Sizov, V. P.; Serebriakov, V. A.; Starikov, A. D.; Khazov, L. D. Opt. Spektrosk.; 38: 1182-1184(Jun 1975). (In Russian)

The spectrum of subnanosecond-pulse laser emission is studied. Considerable broadening of the spectrum is observed with the formation and intensification of a line structure in it. Possible mechanisms are considered for the development of intense spectral "noise" and a line structure when a transparent dielectric is subjected to a powerful subnanosecond pulse.

28884 SELF-DESTRUCTION OF GaAs LASERS WITH ELECTRONIC PUMPING. Antoshin, M. K.; Krasavina, E. M.; Kryukova, I. V.; Sluev, V. I.; Spivak, C. V. (All-Union Scientific Research Inst. of Optical-Physical Measurements, Moscow). Kvantovaya Elektron. (Moscow); No. 9, 1969-1977(1975). (In Russian)

One of the chief problems in the practical use of semiconductor lasers with electron pumping is the destruction of crystals under the action of the laser radiation. The results of experiments involving the incidence of laser radiation on n-type GaAs crystals doped with Te or Sn to concentrations of 1×10^{18} to 4×10^{18}/cm are presented. These crystals were grown by the directed, Czochralski, and floating-zone methods, and the energy of the electron beam was 50 keV, with a pulse duration of 10^{-7} s and a frequency of 50 Hz. The nature of the damage sustained by the GaAs crystals was diagnosed with the use of the MIM-7 optical microscope and the raster electron microscope "Stereoskan-2M."

28885 EFFECT OF OPTICAL HETEROGENEITIES OF THE ACTIVE MEDIUM ON THE OSCILLATION FREQUENCY OF A GAS LASER. Mardanov, R. F. (Kazan Aviation Inst.). Kvantovaya Elektron. (Moscow); No. 9, 1879-1884(1975). (In Russian)

The effect of those forms of optical heterogeneity arising in a laser gas medium under the action of the pumping glow discharge on the natural frequencies of the laser resonator is analyzed. The forms of the heterogeneities were determined by generalizing the results of experimental papers published in the past since a strictly theoretical solution of the problem is extremely complex. It is assumed that the intensity of the field in the resonator is low and that its effect on the physical characteristics of the active medium is negligible. The analysis is begun with an expression for the index of refraction of the gas medium for a particular wavelength in terms of the concentrations of electrons and neutral atoms in the gas, and the contributions of the excited atoms in the operation transition. The methods of reducing the effects of such heterogeneities on the resonator natural frequencies are discussed. The practically interesting problem of the effect of noncoincidences of the axes of symmetry is also examined.

28886 PULSE SUBMILLIMETER LASER FOR DETERMINING THE OPTICAL DENSITY OF A PLASMA. Kutovoy, V. D.; Lesnikov, E. V.; Nikitin, N. V.; Petrov, G. D.; Samarskii, P. A. (All-Union Scientific Research Inst. of Physical-Technical and Radio Engineering Measurements, Moscow). Kvantovaya Elektron. (Moscow); No. 9, 2066-2067(1975). (In Russian)

The description is given of the development and investigation of a pulse submillimeter laser, consisting of a resonator block, a voltage supply source, and a system for supplying the gaseous operating mixture. The resonator is 375 cm long, and is formed by flat brass mirrors 19 cm in. dia inside a glass tube. A picture of the major portion of the equipment is shown together with an oscillogram of the laser pulse, at a wavelength of 337 μ; the interferogram and radiation spectrum of the laser are plotted. The comparatively high power of the radiation and large number of oscillation lines, plus the simplicity and reliability of the laser indicate that the laser will be widely used for plasma diagnostics. (JPRS)

28887 ADJUSTING THE POWER OF A PULSE CO_2 LASER IN THE NINE-MICRON REGION. Karlov, N. V.; Karpov, N. A.; Kovalev, I. O.; Kuz'min, G. P.; Prokhorov, A. M. (Lebedev Inst. of Physics, Moscow). Kvantovaya Elektron. (Moscow); No. 9, 2079-2081(1975). (In Russian)

The question of obtaining radiated power from a laser in the infrared region in as wide a range of wavelengths as possible is discussed in connection with work in laser chemistry. Ordinary dispersion elements are inconvenient for obtaining radiation pulses in the 9 μ region using pulse lasers with CO_2 at atmospheric pressure because of the poor optical stability, complex operation, and reduction in the output energy level. The paper shows how a cuvette with BCl_3 gas introduced into the resonator of such a CO_2 laser can, when the pressure inside the cuvette is varied from units of a mm of Hg to 1 atm., obtains oscillations with an energy of about the same level as the same laser at 10.6-μ wavelength radiation. Details of the experiment are given. (JPRS)

28888 EXPERIMENTAL STUDIES OF UNIFORMITY OF POSITIVE COLUMN OF $He-Cd^+$ LASER DISCHARGE. Mizeraczyk, J. K.; Ziemann, J. (Inst. of Fluid-Flow Machines, Gdansk, Poland). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 23: No. 12, 1001-1004(1975).

The results of experimental studies of uniformity of positive column of $He-Cd^+$ laser discharge are presented. It appears that the possible column is uniform in the discharge conditions typical of $He-Cd^+$ laser. However, a deviation from uniformity was monitored for another discharge condition.

28889 GAS LASER BASED ON COMBUSTION OF HYDROCARBON-AIR MIXTURES. Kozlov, G. I.; Ivanov, V. N.; Koroblev, A. S.; Selezneva, I. K. (Inst. of Problem Mechanics, Moscow). Zh. Eksp. Teor. Fiz.; 68: 1647-1663(May 1975). (In Russian)

Results of an experimental and theoretical study of the unsaturated gain and power of laser radiation in a quasi-continuous gas laser using the combustion products of a hydrocarbon-air mixture are reported. In the experimental part, a laser operating on air mixtures of acetylene, propane, and carbon monoxide with hydrogen was used. It was found experimentally that for gain-optimal values of the deceleration parameters, the gain factor attained .008 per cm, which agreed well with computational results. Maximum value of output power attained was 8.5 kW.

28890 STUDY OF A N_2O GASDYNAMIC LASER. Biriukov, A. S.; Volkov, A. I.; Demin, A. I.; Kudriavtsev, E. M.; Kulagin, I. A.; Sobolev, N. N.; Shelepin, L. A. (Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: 1664-1678(May 1975). (In Russian)

Theoretical and experimental studies of the operation of a N_2O gasdynamic laser with discharge of the working mixture through a slit into a vacuum are reported. Various mixtures of N_2O with N_2, He, CO, and H_2O were investigated, and the kinetics of the lasing processes in each mixture were analyzed. It is shown that contrary to the case of a CO_2 layer, a central role is played here by nonresonant vibrational exchange, which provides additional pumping towards the upper lasing level. The dependence of population inversion and gain on fundamental parameters is calculated. Experimental dependences of gain on pressure, temperature, distance to the slit, and nitrogen content in a N_2O-N_2 mixture were obtained with the aid of a shock tube, and the results were in qualitative and, in some cases, quantitative agreement with theory.

28891 POWER OF HIGH-PRESSURE, GASDYNAMIC LASER. LOSEV, S. A.; Makarov, V. N. Zh. Prikl. Mekh. Tekh. Fiz.; No. 4, 3-7(1975). (In Russian)

A solution is given to the problem of the flow of a relaxing mixture in a gasdynamic laser of carbon dioxide gas. The specific power is calculated for generation of infrared radiation at a gas pressure of 25 and 100 atm at the nozzle inlet. The increase in generation power is noted with increasing initial pressure at a given composition of the mixture and initial temperature. (SJR)

28892 LASER IN THE ULTRAVIOLET RANGE USING ORGANIC DYES WITH PUMPING BY THE PLASMA FOCUS OF A MAGNETOPLASMIC COMPRESSOR. Kozlov, N. P.; Protasov, Yu. S. Prib. Tekh. Eksp.; No. 4, 169-171(1975). (In Russian)

High laser output power, required for solving problems in photochemistry, laser spectroscopy, and the like, was developed using triplet-triplet absorption. The pumping source is supplied by a plasma focus, a discharge with controllable dynamic energy and spectral characteristics, in a magnetoplasmic compressor of the erosion type. A sectional view of the laser is provided. The oscillation is excited in a quartz vessel 120 mm long with a dia of 6 mm, separated from the plasma flow by a quartz tube which is also a filter for cutting off the shortwave radiation of the plasma focus. (JPRS)

28893 He + Se LASER CONSTRUCTION. Telbizov, P. K.; S'btinov, N. V. Prib. Tekh. Eksp.; No. 5, 178-179(1975). (In Russian)

Two structures of He + Se lasers operating in the blue-green regions of the visible spectrum are described. The first structure has a glass envelope with an inner dia of 10 mm, containing seven glass tubes with an external dia of 10 mm, an inner dia of 2 mm, and a length of 80 mm; the second is more convenient because of less stringent limitations, uses a laser tube with an inner dia of 3 mm and an active length of 50 cm, and has two anodes. The advantages and defects of both structures are discussed. The structures of both are illustrated and plots of the output power as a function of the discharge current for both types are presented. Both variants are as convenient for operation as the widely used He + Ne laser types. (JPRS)

28894 LONGITUDINAL-DISCHARGE OSCILLATOR FOR EXCITATION OF PULSE LASERS. Tarasenko, V. F. Prib. Tekh. Eksp.; No. 5, 180-181(1975). (In Russian)

The circuit diagram and structure of an oscillator for pumping lasers are given along with the results of tests of its use for obtaining ultraviolet oscillation with molecular nitrogen. The pumping oscillator is a multistage Blumlein circuit using ceramic capacitors with high dielectric permeability. Use of the circuit yields high E_0/p values at low charge and pulse voltages, where E_0 is the initial electric field intensity and p is the gas pressure. The physical structure of one stage of the oscillator is sketched; besides the capacitors, it contains a recharging inductance whose value is determined by the delay time in the puncture of the operating gas and is a function of the charging voltage, the type and pressure of the gas, the repetition frequency, and the structure of the laser chamber. (JPRS)

28895 STABILIZATION OF THE RADIATION POWER OF A CONTINUOUS CO_2-LASER. Zelenov, A. A.; Raykhman, B. A.; Semenov, E. P. Opt.-Mekh. Prom-st.; No. 6, 71-72(Jun 1975). (In Russian)

In a suggested scheme for the output power stabilization of industrial CO_2-lasers of the controlled parameter type, the current and the control element is the GU-50 pentode. The operation of the laser in the single-mode is described by reference to the block diagram of the stabilization channel. The control of the input voltage in the feedback amplifier by the potentiometer makes possible a steady operation of the feedback system at different voltages on the gas-discharge tube electrodes. Time dependent diagrams of the emissive output power at switched on and switched off feedback systems are shown; they were registered on the recorder by the numerical voltmeter. In this case, the fluctuations of the emissive output power decreased up to 0.05% in five-minute intervals. (JPRS)

28896 TIME CHARACTERISTICS OF SPONTANEOUS EMISSION OF NEON AND HELIUM. Dubovik, M. V. Zh. Prikl. Spektrosk.; 22: 1020-1026(Jun 1975). (In Russian)

The time characteristics of discharge radiation in neon and helium mixtures at various pressures and ratios of the components were studied. It was found that the 2s and 2p levels of neon at pressure below 1 mm Hg are weakly populated during postluminescence. During the excitation pulse, the largest population rate is observed in the 2p 1 level. Helium levels 3-3P, 3-3S and 2-3P are well populated during postluminescence at pressures below 1 mm Hg. The 3-3S level during postluminescence is more heavily populated than during the excitation pulse as a result of the decisive role of recombination processes. The population of neon 2s and 2p levels during postluminescence increases upon addition of helium.

28897 LASER FREQUENCY STABILIZATION BY MEANS OF SATURATION DISPERSION. Kramer, G.; Weiss, C. O.; Helmcke, J. (Physikalisch-Technische Bundesanstalt, Braunschwick). Z. Naturforsch., A; 30: 1128-1132(Sep 1975).

A method for frequency stabilization of 3.39 μ He-Ne lasers, which makes use of the saturation dispersion of the ν 3, P(7) methane transition is described. It is shown that with lasers which are stabilized by saturation effects, the absorptive and dispersive properties of the saturation resonance are not precisely distinguishable. This leads to a slightly asymmetric resonance and a shift of the apparent line-center. When using the dispersion for stabilization, the asymmetry can be detected and eliminated. Frequency stabilization to the true line center with an accuracy of 5×10^{-12} was attained.

28898 TUNABLE LASERS IN LASER SPECTROSCOPY. Zuev, V. E.; Lopasov, V. P.; Makogon, M. M. pp 112-117 of Optical Wave Propagation in the Atmosphere. Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

A brief review is given of existing classes of frequency-tunable lasers and possible areas for their effective application. It is noted that the use of tunable lasers in spectroscopy makes it possible to study the fine structure of absorption lines, determine the constants of vibrational-rotational molecular reactions, and obtain information on intermolecular as well as intramolecular interactions. Instruments discussed include parametric oscillators, ternary-compound semi-conductor lasers, spin-flip Raman lasers, solid-state lasers, and organic-dye lasers.

28899 LINE NARROWING IN A SYMMETRY BROKEN LASER. Chow, W. W.; Van Stryland, E. W.; Scully, M. O. (Univ. of Arizona, Tucson). Opt. Commun.; 15: 6-9(Sep 1975).

The power spectral density of a laser subjected to a symmetry breaking injected signal is calculated via the quantum noise operator approach. The resulting spectrum is sharpened in a manner reminiscent of the line narrowing which occurs in the Lamb-Moessbauer effect. It is further noted that these considerations are potentially of interest in producing high intensity fields in small focal volumes.

28900 LASER SOURCES. Leone, S. R.; Moore, C. B. (Univ. of California, Berkeley). pp 1-27 of Chemical and Biochemical Applications of Lasers. Volume 1. New York; Academic Press, Inc. (1974).

An introduction to lasers is presented. The general principles of laser physics is reviewed and the chief characteristics of commercial gas lasers, solid state lasers, dye lasers, chemical and molecular lasers, and semiconductor lasers are described. The basic processes involved in various nonlinear optical phenomena are described, including second harmonic conversion, sum and difference frequency generation, triple harmonic generation, parametric conversion, and the stimulated Raman effect.

28901 VIBRATIONAL RELAXATION OF HCl/v equals 1/ IN THE PRESENCE OF SEVERAL DIATOMIC MOLECULES AT 295 TO 750°K. Bott, J. F.; Cohen, N. (Aerospace Corp., Los Angeles). J. Chem. Phys.; 63: 1518-1524(15 Aug 1975).

Results are reported for measurements of the vibrational relaxation of HCl (v equals 1) by HF, HBr, H_2, D_2, N_2, and C_{12} at temperatures between 295 and 700°K in a series of shock-tube laser-induced fluorescence experiments. Deactivation rates for HCl (v equals 1) in each gas are determined, energy exchanges between HCl (v equals 1) and D_2 are considered, and relaxation-rate coefficients are plotted against temperature. The data indicate only moderate to weak temperature dependences, and the results of this study are found to be in good agreement with previous measurements at room temperature. Quantitative comparisons are made among the relaxation times of HCl (v equals 1) in the different gases.

28902 COLLINEAR ACOUSTO-OPTICAL TUNABLE FILTER AND ACOUSTO-OPTICALLY TUNABLE LASER. Feichtner, J. D. (to Westinghouse Electric Corp.). US Patent 3,926,814. 23 Dec 1975. Filed Date 25 Feb 1974. 8p.

A collinear, acousto-optical, tunable filter is described. A well-collimated, polarized beam of light enters a crystal of Tl_3AsSe_3. A sound wave generated in the crystal collinear to the light rotates the plane of polarization of the light. A method of analyzing a light spectrum is also disclosed. An acousto-optical filter between the mirrors of a laser is also described.

28903 LASER POWER SUPPLY. Bernstein, D. (to Secretary of the Air Force). US Patent 3,928,819. 23 Dec 1975. Filed Date 20 Nov 1974. 4p.

The laser power supply includes a regulator which has a high voltage control loop based on a linear approximation of a laser tube negative resistance characteristic. The regulator has independent control loops for laser current and power supply high voltage.

28904 HIGH GAIN PULSED ION LASER. Pappalardo, R. G.; Smith, R. (to GTE Labs. Inc.). US Patent 3,928,820. 23 Dec 1975. Filed Date 25 Nov 1974. 8p.

A high gain pulsed ion laser is described in which a short discharge pulse of less than about 2.0 microseconds is applied to a discharge tube in which oxygen is present in an amount sufficient to establish an oxygen pressure in the range between about 10 and 100 millitorr. The pulsed output from the ion laser occurs during the "afterglow" of the discharge pulse and is attributed to doubly ionized oxygen. The wavelength of the output may be selected from certain lines in the visible and ultraviolet portions of the electromagnetic spectrum.

28905 METHOD OF REDUCING LIGHT LEAKAGE IN LASERS. White, M. B. (to Secretary of the Navy). US Patent 3,928,818. 23 Dec 1975. Filed Date 17 Oct 1974. 6p.

A Q switched and cavity dumped laser system is provided in which a 45^0 Faraday rotator and an auxiliary cavity mirror are disposed in the beam path to compensate for the polarization change caused by thermally stressed laser rods.

28906 RING LASER FREQUENCY BIASING MECHANISM. McClure, R. E. (to Sperry Rand Corp.). US Patent 3,927,946. 23 Dec 1975. Filed date 21 Mar 1968. 6p.

A ring laser cavity including a magnetically saturable member for differentially phase shifting the contradirectional waves propagating in the laser cavity, the phase shift being produced by the magneto-optic interaction occurring between the light waves and the magnetization in the cavity forming component as the light waves are reflected therefrom is described.

28907 METHOD AND APPARATUS FOR OPERATING LASER. Hellwarth, R. W. (to Hughes Aircraft Co.). US Patent 3,928,815. 23 Dec 1975. Filed date 3 Jun 1974. 10p.

A Q-switched laser is disclosed for providing large pulses of laser energy. A laser medium is employed wherein the lifetime of the upper energy level for the lasing transition is sufficiently long to permit a substantial excess population inversion to develop when the medium is excited under a condition of low regeneration. The laser medium is excited to a condition of population inversion under a first regenerative condition insufficient to achieve laser oscillation but allowing a substantial excess population inversion to develop. Subsequently, the regenerative condition is switched to a condition of high regeneration sufficient to cause the laser medium to emit a pulse of light having a peak power substantially greater than that which would have emitted if the first regenerative condition were not previously provided.

28908 FAR INFRARED WAVEGUIDE LASER. Hartwick, T. S.; Hodges, D. T. Jr. (to Secretary of the Air Force). US Patent 3,928,816. 23 Dec 1975. Filed date 12 Jun 1974. 4p.

A far infrared (FIR) laser is provided which uses a dielectric or metal tube waveguide resonator. A CO_2 or CO waveguide laser is utilized to pump the FIR laser. (auth)

28909 MAGNETO-OPTICAL PROPERTIES OF BOUND-STATE TRANSITIONS, AND APPLICATIONS. Tanton, G. A.; Meyer, H. C. (Physical Sciences Directorate, Redstone Arsenal, AL). J. Opt. Soc. Am.; 65: No. 11, 1261-1263(Nov 1975).

Calculated and experimentally determined plane-of-polarization rotation curves are presented that demonstrate that magneto-optical properties of transitions between degenerate energy levels may be used to design low-loss components for laser systems over the uv to far-ir spectral region. For devices such as optical rotators and modulators, magneto-optical properties of discrete-energy-level transitions offer significant advantages over bulk properties that are used in conventional designs. (auth)

28910 $In_xGa_{1-x}As$ INJECTION LASERS. Ota, T.; Yamaguchi, M.; Mizushima, Y.; Urisu, T.; Kojima, H.; Oe, K. (Nippon Telegraph and Telephone Public Corp., Tokyo). Jpn. J. Appl. Phys.; 14: 1073-1074(Jul 1975).

The possibility of forming high-quality p-n junctions directly on GaAs substrates is discussed along with a comparison of the electroluminescence (EL) properties of these junctions with those of p-n junctions with a compositionally graded layer. The $In_xGa_{1-x}As$ p-n junctions are prepared in a Ga-In-HCl-As_4-H_2 system by an ordinary vapor-phase growth technique on a Te-doped GaAs substrate. LEDs from both types of samples are fabricated to examine spontaneous EL properties. Fabry-Perot laser diodes are also fabricated from both types of samples. Typical dependences of emission intensities on pulsed current densities are presented and discussed. Experimental results show that $In_xGa_{1-x}As$ p-n junctions with compositionally graded layers exhibit nearly ten times better EL properties than those of the p-n junctions without graded layers.

28911 CONTINUOUS WAVE NEODYMIUM YAG LASER. Wolinski, W.; Nowicki, M.; Niechoda, Z.; Cherka, M. (Warszawa Politehnika, Warsaw). Elektronika; 16: No. 6, 241-243(1975). (In Polish).

Parameters and performance of a 1.4-W Nd-YAG laser pumped by two 1-kW halogen flash lamps are reported. The effect of optical cavity configuration and temperature of the water coolant on output power is studied. Short-term and long-term stability of the laser output were measured.

28912 SOME ASPECTS OF THE KINETICS OF EMISSION OF SOLID-STATE SWEEP LASERS. Anokhov, S.P.; Kravchenko, V.I.; Khanin, Y.I.; Khizhnyak, A.I. (Institute of Physics, Academy of Sciences of the Ukrainian SSR, Kiev). Sov. J. Quantum Electron. 6: No. 1, 9-14 (Jan 1976).

Rate equations are used in an analytic investigation of the process of formation of the spectrum of a single spike emitted by a solid-state sweep laser. A boundary separating basically different fast and slow sweep regions is established in the plane of the principal parameters of a sweep laser (these parameters are the sweep rate, pump level, and selectivity of a dispersive resonator). The spectral and kinetic characteristics of the laser emission are analyzed as a function of the sweep rate. The concept of the sweep laser threshoid is refined. It is shown that the theoretical conclusions are in good agreement with the experimental results obtained for a neodymium-glass sweep laser. (auth)

28913 A CONTRIBUTION TO THE DEVELOPMENT OF cw RECOMBINATION LASERS. Bashkin, A.S.; Oraevskii, A.N. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 6: No. 1, 14-17 (Jan 1976).

A theoretical analysis is given of thermally pumped cw recombination lasers and those utilizing mixing of reagents. Allowance is made for the limiting parameters of gas streams. An expression obtained for the gain of such lasers is considered from the point of view of the necessary cooling, initial concentration of the reagents, and optimal wavelength. A comparison is made of the gains achieved so far for both pumping methods in the case of specific active media. (auth)

28914 METHOD FOR ESTABLISHING A QUANTUM FREQUENCY STANDARD IN THE VISIBLE RANGE USING ATOMIC ABSORPTION LINES AND A cw DYE LASER. Letokhov, V.S.; Pavlik, B.D. (Institute of Spectroscopy, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 6: No. 1, 32-38 (Jan 1976).

A theoretical analysis is made of the self-stabilization of the frequency of a cw dye laser with a nonlinear absorption cell. It is shown that the self-stabilization effect may be anomalously large when use is made of the forbidden (intercombination) transitions in alkaline earth atoms and this may increase the short-term frequency stability of dye lasers by between two and four orders of magnitude. The absence of a hyperfine structure and other characteristics of the transitions discussed suggest that the frequency reproducibility may be 10^{-13} or better. (auth)

28915 RELAXATION OF ACTIVE LEVELS IN CO LASER DUE TO CO*-CN COLLISIONS. Ochkin, V.N.; Sobolev, N.N.; Trubacheev, E.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 6: No. 1, 38-43 (Jan 1976).

An experimental check was made of the postulated mechanism of relaxation of vibrationally excited CO* molecules in collisions with CN radicals. Calculations and experimental results indicated that the formation of the CN radicals in electronically excited states was due to collisions with the vibrationally excited CO* molecules. The cross section of this process was 10^{-13}–10^{-14} cm^2. The populations of the CN($B^2\Sigma$, $A^2\Pi$) states were determined as a function of the discharge current, pressure and composition of laser mixtures, cooling conditions, and occurrence of stimulated emission. In mixtures free of oxygen, the rate of relaxation of the vibrational energy of the CO molecules colliding with CN was fairly high and comparable with the rate of relaxation as a result of spontaneous infrared emission and it should be allowed for in theoretical calculations. In mixtures containing oxygen, the influence of CN on the relaxation of the active levels was negligible because of a strong reduction in the concentration of CN in the ground state. The influence of CN on the populations of the active vibrational levels was also considered. (auth)

28916 ELECTRON-BEAM-PUMPED SEMICONDUCTOR LASER UTILIZING MULTILAYER $Ga_{1-x}In_xAs_{1-y}Sb_y$ HETEROSTRUCTURES. Bondar', S.A.; Borisov, N.A.; Galchenkov, D.V.; Lavrushin, B.M.; Lebedev, V.V.; Strel'chenko, S.S. (P. N. Lebedev

Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 6: No. 1, 50-53 (Jan 1976).

Laser emission was obtained from $Ga_{1-x}In_xAs_{1-y}Sb_y$ solid solutions in the wavelength range 0.9–1.08 μ and the principal parameters of this laser were determined when it was pumped by an electron beam. The difference between the threshold current densities in the case of multilayer heterostructure was attributed to a redistribution of nonequilibrium carriers between the layers and establishment of a population inversion in the layer with the narrowest energy gap. An analysis was made of the possibility of a further reduction in the threshold current density by a suitable selection of the layers in a heterostructure and by reduction of the thickness of the active layer. (auth)

28917 INVESTIGATION OF THE CHARACTERISTICS OF A CHEMICAL HF LASER EXCITED BY CO_2 LASER PULSES. Galochkin, V.T.; Zavorotnyi, S.I.; Kosinov, V.N.; Ovchinnikov, A.A.; Oraevskii, A.N.; Starodubtsev, N.F. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 6: No. 1, 66-69 (Jan 1976).

An investigation was made of the energy and time characteristics and the spectra of a pulse chemical HF laser utilizing the reaction of sulfur hexafluoride with hydrogen and initiated by pulse CO_2 laser radiation. A comparison of the characteristics of HF lasers excited by electric discharges and infrared radiation suggested a possible mechanism of the excitation and dissociation of the SF_6 molecules, as well as further studies of the reactions initiated by high-power infrared radiation. (auth)

28918 ANALYSIS OF STIMULATED EMISSION FROM A cw CHEMICAL DIFFUSION LASER WITH A CHAIN EXCITATION MECHANISM OPERATING AT LOW DEGREES OF DISSOCIATION OF MOLECULAR FLUORINE. Oraevskii, A.N.; Pimenov, V.P.; Stepanov, A.A.; Shcheglov, V.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 6: No. 1, 73-79 (Jan 1976).

An analysis is made of the possibility of using the chain reaction between fluorine and hydrogen for increasing the efficiency of a cw chemical laser. A simplified isothermal model of this laser is developed allowing for the reagent mixing effect. Different mixing regimes are considered. (auth)

28919 RELATIONSHIP BETWEEN THERMO-OPTIC CONSTANTS OF NEODYMIUM GLASSES AND LASER CHARACTERISTICS. Vakhmyanin, K.P.; Mak, A.A.; Mit'kin, V.M.; Popova, L.G.; Raba, I.V.; Soms, L.N.; Stepanov, A.I. Sov. J. Quantum Electron. 6: No. 1, 106-109 (Jan 1976).

Thermal deformations of active elements made of neodymium glasses are analyzed allowing for the temperature dependences of the thermo-optic constants. The optimal temperature range for the use of active elements is determined theoretically and experimentally. The influence of the values of the thermo-optic constants P and Q on the angular and energy characteristics of periodically operating lasers is considered. (auth)

28920 INVESTIGATION OF THE EMISSION LINE WIDTH OF AN INJECTION LASER IN STRONG AND WEAK FIELDS. Mironov, Y.M.; Molochev, V.I.; Nikitin, V.V.; Semenov, A.S. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 6: No. 1, 123-124 (Jan 1976).

An investigation was made of the behavior of the temporal coherence length of the radiation emitted from single-channel injection lasers when the radiation intensity was varied. The rate of rise of the coherence length with increasing intensity slowed down sharply in the range $\sim 10^5 W/cm^2$, which corresponded to a transition from a weak to a strong field. The field was considered strong when the interband stimulated emission time became shorter than the energy relaxation time. Measurements indicated that the temporal and spatial coherence of the radiation emitted from single-channel injection lasers was comparable with the coherence of the radiation emitted from gas lasers. (auth)

28921 EXPERIMENTAL INVESTIGATION OF THE POSSIBILITY OF USING A HIGH-CURRENT DISCHARGE FOR THE OPTICAL PUMPING OF AN Xe_2 LASER. Borovich, B.L.; Zuev, V.S.; Stavrovskii, D.B. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. J. Quantum Electron. 6: No. 1, 125-126 (Jan 1976).

An investigation was made of an electric discharge which was initiated by an exploding wire in a Textolite gap 1.3–2 mm wide filled with air at a pressure of 0.25–1 atm. The discharge expanded at a velocity of 6–11 km/sec. A discharge in xenon expanding at a velocity of 7–8 km/sec should be capable of pumping an Xe_2 laser with radiation emitted from a layer of strongly compressed gas located between the moving discharge boundary and the undisturbed gas. (auth)

28922 TUNABLE ORGANIC DYE LASER FOR RESONANCE INTERFEROMETRY AND HOLOGRAPHY. Ostrovskii, Y.I.; Tanin, L.V. (A. F. Ioffe Physicotechnical Institute of the Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Tech. Phys. 20: No. 8, 1118-1123 (Aug 1975).

A tunable rhodamine 6G dye laser based on the Raduga laser (with coherent pumping) has been developed and tested. This laser works in single, double, and multifrequency modes with a pulse energy of 10^{-3} J and power of about 0.1 MW and is suitable for hologram applications. The laser linewidth has been reduced to about 0.3 Å. The spatial coherence function of the laser output is examined by two independent methods (interference and holographic). The coherent zone (to a level of 0.2 relative to the center) of the front end of the laser has an area of 1.3×1.3 and 0.8×1.4 mm^2 (for ruby laser energies of 0.8 and 1.2 J). The values of the spatial coherence function (for a single laser pulse) obtained by two different methods (microphotometric measurements of the intensity distribution across the front of the laser and holography alone) are compared. Holograms are made of two dimensional diffuse objects. The densities of ground state sodium atoms in a DC arc and in the flame of an alcohol lamp are determined by resonance interferometry. (auth)

28923 CHEMICAL PULSE LASER USING A MIXTURE OF $D_2 + F_2 + CO_2 + He$. Basov, N. G.; Zavorotnii, S. I.; Markin, E. P.; Nikitin, A. I.; Oraeveskii, A. N.; Borovich, B. L.; Grigor'ev, P. G.; Zuyev, V. S. Kvantovaya Elektron. (Kiev); 1: No. 3, 560-564(1974). (In Russian).

Triggering of a pulse chemical laser using $D_2 + F_2 + CO_2 + He$ when the pressure of the mixture is close to atmospheric is reported. The principal characteristics of the device are given: energy in the pulse about 5 J; specific power output 1.2×10^{-2} J/cc; and emission pulse duration about 10 μs. It is experimentally established that carbon dioxide molecules act as an inhibitor of the process of chain branching of self-ignition. A light pulse is used to initiate the chemical process. It is shown that the use of photo-initiating components increases the effectiveness of utilization of the light source. (JPRS)

28924 DESIGNS AND SOME POSSIBLE APPLICATIONS OF SEMICONDUCTOR LASERS WITH ELECTRON BEAM EXCITATION (SURVEY). Bogdankevich, O. V. Kvantovaya Elektron. (Kiev); No. 6, 5-22(1973). (In Russian).

An examination is made of designs of semiconductor lasers with electron stimulation, their characteristics, and requirements for electron optics. The characteristics of laboratory models of such lasers are presented, as well as those of industrially produced, sealed laser tubes. The paper discusses a number of possible applications of electron-stimulated semiconductor lasers in data processing systems, projection television, metrology, and spectroscopy. (JPRS)

28925 CIRCUIT FOR PRECISION THERMOSTATING BASED ON AN INTEGRATED MICROCIRCUIT. Venkin, G. V.; Kulyuk, L. L.; Maleev, D. I. (Moscow State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1286-1287(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 222-223(1975).

A simple and compact circuit is described which allows thermal stabilization of small volumes within 0.01°K in the presence of significant temperature gradients. Simplicity and reliability are assured by using a microcircuit.

28926 LASER FOR THE ULTRAVIOLET RANGE BASED ON ORGANIC DYES WITH PUMPING BY MEANS OF THE PLASMA FOCUS OF A MAGNETOPLASMA COMPRESSOR. Kozlov, N. I.; Protasov, Yu. S. (Moscow Higher Technical School). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1215-1217(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 169-171(1975).

The construction of an ultraviolet laser based on a solution of paraterphenyl in ethanol is described which operates at a pressure $\sim 10^{-6}$ torr and has optical pumping by radiation from the plasma focus of a magnetoplasma compressor of the erosion type. The electrical energy introduced into the discharge amounts to ~1710 J, the lasing energy is ~2.6 J, and the peak power of the generating radiation is ~26 MW.

28927 LIGHT-FREQUENCY CONVERTER BASED ON A SOLUTION OF AN ORGANIC DYE. Buzinov, N. M.; Dmitriev, V. G.; Ershov, A. G.; Tavetkova, O. Yu.; Cherednichenko, O. B. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1218-1219(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 171-172(1972).

A light-frequency converter based on a solution of an organic dye is described which may be used as an attachment to the LTIPCh-6 batch-manufactured laser based on alumo–yttrium garnet. The converter allows smoothly tunable radiation to be obtained in the range of wavelengths from 550 to 610 nm with a line width not exceeding 0.2 nm, a radiation power 0.25 MW, and a pulse repetition frequency of up to 100 Hz.

28928 INVESTIGATION OF OPTICAL NONHOMOGENEITIES WHICH ARISE IN THE WORKING MEDIUM OF PHOTODISSOCIA-

TION LASERS DURING EMISSION. Golubev, L. E.; Zuev, V. S.; Katulin, V. A.; Nosach, V. Yu.; Nosach, O. Yu. Kvantovaya Elektron. (Moscow); No. 6, 23-30(1973). (In Russian).

An experimental study on optical nonhomogeneities which arise in the working medium of photodissociation lasers during emission is described. The cross gradient of the index of refraction may reach 10^{-4} cm^{-1}. On the basis of experimental data it is concluded that the principal role in the development of nonhomogeneities is played by gasdynamic mixing of the working medium, rather than by the change in polarizability of the molecules during photodissociation. The formation of waves of nonhomogeneities at the walls of the laser cell is apparently due to adsorption of the working gas on the walls. The change in polarizability of C_3F_7I molecules during photodissociation was estimated. A photodissociation laser was created with emission divergence close to the diffraction value. (JPRS)

28929 CONCERNING THE POSSIBILITY OF CHANGING THE DURATION OF A LASER PULSE WITH MODE LOCKING BY BIREFRINGENT CRYSTAL PLATES. Verevkin, Yu. K.; Daume, E. Ya.; Novikov, M. A. Kvantovaya Elektron. (Moscow); No. 6, 119-121(1973). (In Russian).

A method is proposed for continuous regulation of the duration, carrier frequency, and spectral width of a laser with mode locking based on the use of a polarization filter. The method was used for selecting modes of a neodymium glass laser. Reduction of spectral width to 3 Å does not lead to an increase of minimum pulse duration in our experiments (10^{-11} s) but only increases the stability of such a laser. A further reduction in the width of the emission spectrum to 0.5 Å led to an increase in duration to 50 ns. (JPRS)

28930 MECHANISMS OF EMISSION OF MOLECULAR LASERS IN THE FAR INFRARED SPECTRAL REGION. Gordiyets, B. F.; Reshetnyak, S. A.; Shelepin, L. A. Kvantovaya Elektron. (Moscow); 1: No. 3, 591-603, 707(1974). (In Russian).

The kinetics of physical processes in lasers using diatomic and polyatomic molecules emitting in the submillimeter and far infrared regions of the spectrum were examined. A detailed investigation was made of rotational relaxation for a system of diatomic molecules. Analytical functions were found for the distribution of populations of rotational levels in the presence of a source of rotationally excited molecules. Estimates made for the adiabatic region of the rotational spectrum show the feasibility of creating effectively operating lasers. Emission mechanisms are investigated for polyatomic molecules. A brief discussion is presented on problems of creating an inverse population on the rotational levels of weakly asymmetric tops. The emission mechanism on vibrational rotational transitions was studied. Several specific water-vapor laser schemes are proposed which generate high-power emission in the cw mode. (JPRS)

28931 INFLUENCE OF RADIAL NONUNIFORMITY OF AMPLIFICATION AND LOSSES ON THE PROPERTIES OF MULTIPULSE EMISSION OF A LASER WITH PASSIVE GATES. Mikhnov, S. A.; Matyushkov, V. E.; Andrenchev, V. A. Kvantovaya Elektron. (Moscow); No. 6, 90-94(1973). (In Russian).

This is an experimental study of one of the causes of reduction of efficiency of multiple-pulse lasers with passive shutters — radial nonuniformity of amplification and losses. Proposed and tested passive shutters with radially variable transparency to equalize losses and amplifications for beams passing through any point of the cross section of the rod are described. The optimum variability of shutter transmission was determined for ruby rods with various states of the lateral surface. The use of such Q-switches appreciably increased the power and efficiency of the laser. (JPRS)

28932 INFLUENCE WHICH THE STABILITY OF THE SOURCE OF SUPPLY OF A RING LASER HAS ON THE PARAMETERS OF A MEASUREMENT CONVERTER OF ANGULAR VELOCITY. Zakharenko, Yu. G.; Mel'nikov, N. A.; Privalov, V. E. Tr. Metrol. Inst. SSSR; No. 156, 125-129(1974). (In Russian).

Modern ring lasers can be used to measure angular velocity and change of angle with an accuracy of the order of 10^{-5} to 10^{-6}. To develop standards for measuring the angular parameters of motion the beat frequency of opposed waves of the ring laser must be stable within an order of 10^{-6} to 10^{-8}. One of the factors which determine this stability is the stability of the discharge current in a gas ring laser. An analysis of the requirements for the discharge supply source used in an angular velocity measurement converter was made. An examination was made of a double stabilization circuit. The workability of the circuit was experimentally verified. (JPRS)

28933 WAVEGUIDE LASER THEORY. Preobrazhenskii, N. G.; Shirikova, S. L. (Inst. of Theoretical and Applied Mechanics, Moscow). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 17-21(1975). (In Russian).

The role of the diffusion of the components of the gaseous mixture in the generation mechanism of waveguide CO_2 lasers is analyzed. A method for the reduction of the multicomponent problem of diffusion with dissipation to the one-component problem is proposed. For the cylindrical waveguide the supposition of the relaxation mode is examined. The diffusion contribution in the loss of electromagnetic energy is evaluated for cases of field hybrid modes EH_{11} of the dielectric waveguide. The rapid increase of loss for waveguide tubes of SiO_2 and the preservation of the filtration properties of the laser under conditions considering diffusion are noted. (tr-auth)

28934 ANALYSIS OF THE BEHAVIOR OF A MULTIMODE GAS LASER WITH RESONATOR OF VARIABLE OPTICAL LENGTH. I. Theory. Vorobeichikov, E. S.; Parygin, V. N.; Popov, L. N. Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 113-120(1975). (In Russian).

A system of equations was obtained by a semiclassical method. These equations describe the behavior of two- and three-mode lasers in a regime of variable optical length of the resonator. An analysis was made of the system of equations obtained. (JSR)

28935 TUNABLE ORGANIC DYE LASER EXCITED BY NITROGEN LASER. Bychkov, Yu. I.; Losev, V. F.; Revenko, V. I.; Tarasenko, V. F.; Timofeev, V. B. (Inst. of Atmospheric Physics, Moscow). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 134-136(1975). (In Russian).

The construction of the N_2 laser and its power as a function of the repetition frequency were discussed. The pumping system for the organic dye laser, constructed in the usual fashion, was a transverse variant of the usual techniques. The tuning range and pulse power of the laser combination using three different organic dyes were tabulated. (JSR)

28936 ANALYSIS OF THE BEHAVIOR OF A MULTIMODE GAS LASER WITH RESONATOR OF VARIABLE LENGTH. II. Experiment. Vorobeichikov, E. S.; Parygin, V. N.; Popov, L. N. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 141-143(1975). (In Russian).

An experimental study was made of the behavior of a two- and three-mode He–Ne laser with $\lambda = 0.63$ in the regime of variable optical length of the resonator. The experimental results agree with the theoretical predictions. (JSR)

28937 DYNAMIC CHARACTERISTICS OF A He-Ne LASER AT 0.63 μM. Guskov, L.N.; Troshin, B.I. Opt. Spectrosc. (USSR) 39: No. 5, 528-531 (Nov 1975).

The response of lasing intensity to modulation of the discharge current in the 10^{-3}–10-MHz range is studied experimentally. Interpretation of the results is based on consideration of the simultaneous action of two mechanisms; the dynamic behavior of the level population of the active medium that determines the creation of population inversion of the lasing transition and the attenuation of the field in the resonator. (auth)

28938 SHORT He-Ne LASER AT 3.39 μM IN A TRANSVERSE MAGNETIC FIELD. Antipov, B.A.; Pyrsikova, P.D.; Sapozhnikova, V.A. Opt. Spectrosc. (USSR) 39: No. 5, 532-534 (Nov 1975).

The effect of a transverse magnetic field from 0 Oe to 3000 Oe on the output intensity of a short single-mode laser with a wavelength of 3.39 μm is investigated. The experiment was carried out under conditions of the continuous tuning of the resonator length on the center frequency of one of the Zeeman components shifted by the magnetic field. A number of characteristics of the laser behavior in the transverse magnetic field were noted when the tube diameter, the Q of the resonator, and the method of excitation of the discharge were varied. (auth)

28939 PHOTOLYTIC PUMPING OF THE IODINE LASER BY XeBr. Swingle, J.C.; Turner, C.E. Jr.; Murray, J.R.; George, E.V.; Krupke, W.F. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Appl. Phys. Lett. 28: No. 7, 387-388 (1 Apr 1976).

The efficiency for producing fluorescence from the 220–340-nm bands of XeBr has been measured to be 11±5% in an electron-beam-driven device, a value consistent with an assumed kinetic model. The photolytic pumping of the 1.315-μm atomic iodine laser is demonstrated using this narrow-band fluorescer. (auth)

28940 POSITIVE GAIN MEASUREMENTS ON THE 3350-Å CONTINUUM BAND OF Hg_2. Schlie, L.A.; Guenther, B.D.; Rathge, R.D. (Air Force Weapons Laboratory (AFSC), Kirtland Air Force Base, New Mexico 87117). Appl. Phys. Lett. 28: No. 7, 393-396 (1 Apr 1976).

A $He\text{-}Cd^+$ laser operating at 3250 Å and an Ar^+ laser at 3511 Å and 3638 Å have been used to probe for gain on both sides of Hg_2 3350-Å ($A^3\Pi_u \rightarrow X^1\Sigma_g^+$) continuum band in Hg vapor at a pressure of 3.75 atm that was pumped by a 1.5-MeV 600-J 20-nsec electron beam. This letter presents the first observation of positive gain on this

3350-Å band of Hg$_2$. The results indicate that the stimulated emission cross section for this band is larger than any associated photoionization process in the Hg vapor and has a magnitude of approximately 10^{-18} cm^2. Also, raising the temperature of the vapor above its saturation value increases the maximum value and duration of the observed gain, indicating that the population of the upper level of this transition is being fed by a temperature-dependent internal energy reservoir in the Hg. (auth)

28941 TIME-RESOLVED PUMP DEPLETION IN *n*-InSb RAMAN SPIN-FLIP LASER. Figueira, J.F.; Cantrell, C.D.; Rink, J.P.; Forman, P.R. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). Appl. Phys. Lett. 28: No. 7, 398-400 (1 Apr 1976).

We have observed a strong transient optical absorption in *n*-InSb ($n=10^{16}$ cm^{-3}) induced by an intense (2 MW cm^{-2}) 10.6-μm laser beam at 2 K. Detailed studies of the time history of the transmitted 10.6-μm beam and the spin-flip Raman laser pulse produced in the InSb show that the 10.6-μm absorption lasts for $\gtrsim 100$ ns, and that spin-flip lasing occurs only at the beginning of the intense portion of the 10.6-μm pump pulse and after the absorption has disappeared. (auth)

28942 LIQUID ARGON COOLED CO LASER. Barry, J.D. (SAMSO/SKX, Space Laser Communications, P. O. Box 92960, Worldway Postal Center, Los Angeles, California 90009). Appl. Opt. 15: No. 3, 606-607 (Mar 1976).

It is demonstrated that He-CO and He-air-CH_4 lasers perform better when operated with liquid argon cooling at 87.3°K than with liquid nitrogen cooling at 77.35°K. (AIP)

28943 LINE SUPPRESSION AND SINGLE LINE PERFORMANCE OF A cw HF CHEMICAL LASER. Sentman, L.H. (University of Illinois, Aeronautical & Astronautical Engineering Department, Urbana, Illinois 61801). Appl. Opt. 15: No. 3, 744-747 (Mar 1976).

Sentman's rotational nonequilibrium model of cw chemical laser has been used to examine the effect of line suppression and single line operation on laser performance. The results indicate that (1) even when lines containing upwards of 30% of the multiline power are suppressed, there will be only about a 10% decrease in the power produced, and (2) with proper line choice, better than 50% of the multiline power may be obtainable in the single line mode. (auth)

28944 DIODE LASERS FOR GAS ANALYSIS: SOME CHARACTERISTICS. Hill, J.C.; Montgomery, G.P. Jr. (General Motors Corporation, Research Laboratories, Warren, Michigan 48090). Appl. Opt. 15: No. 3, 748-755 (Mar 1976).

We report studies of $Pb_{1-x}Sn_xTe$ and $Pb_{1-x}Ge_xTe$ laser characteristics which affect their performance in high-sensitivity gas analysis. In $Pb_{1-x}Sn_xTe$, the rates at which the energy gap E_g and the individual cavity mode frequencies $\bar{\nu}$ tune with current are consistent with published data. Single-mode operation typically occurs near threshold; at higher currents, multimode operation is common. In $Pb_{1-x}Ge_xTe$, E_g and $\bar{\nu}$ tune more slowly, and multimode operation generally occurs. High-resolution absorption measurements on C_2H_4(950 cm^{-1}) and NH_3(931 cm^{-1}) indicate that the frequency reproducibility of the lasers is adequate for trace gas analysis. Such analysis has been performed on calibrated samples of C_2H_4 in N_2 at atmospheric pressure. The minimum detectable C_2H_4 concentration for a 10-cm path was between 17 ppm and 50 ppm, in good agreement with the 30 ppm estimated for detector-noise-limited operation. Effects of detector and laser noise detection sensitivity are discussed. (auth)

28945 PULSED uv NITROGEN LASER: DYNAMICAL BEHAVIOR. Richter, P.; Kimel, J.D.; Moulton, G.C. (Florida State University, Physics Department, Tallahassee, Florida 32306). Appl. Opt. 15: No. 3, 756-760 (Mar 1976).

Using the time dependent rate equations, the dynamical behavior of a high power pulsed N_2 laser radiating at 337.1 nm is derived. The threshold conditions are given. The output peak power and pulse width as a function of length and initial inversion density are shown. The theoretical results derived are compared with experimental data and are found to be in good agreement. (auth)

28946 CHEMICAL PUMPING OF THE WATER VAPOR LASER. I. Downey, G.D.; Robinson, D.W. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218). J. Chem. Phys. 64: No. 7, 2854-2857 (1 Apr 1976).

Flash photolysis of mixtures of $O_2/H_2O/O_3$ leads to lasing at 357.53 cm^{-1}. Emission at this wavenumber coincides with that of the strongest line that is observed from both the pulsed and cw water vapor discharge laser. Accordingly it is assigned to the $(001)6_{33}$–$(020)5_{50}$ transition in water. The pumping scheme $O_3 \rightarrow^{h\nu} O(^1D)+O_2(^1\Delta_g)$, (1); $O(^1D)+O_2(^3\Sigma^-_g) \rightarrow O_2(^1\Sigma^+_g)+O(^3P)$, (2); $O_2(^1\Sigma^+_g)+H_2O \rightarrow O_2(^1\Delta_g)+H_2O^\dagger$, (3), where $H_2O^\dagger$ subsequently lases, is consistent with all the experimental observations. Computer modeling of this sequence of reactions reproduces both the observed pulse's profile and its onset delay after flash initiation. (auth)

28947 CHEMICAL PUMPING OF THE WATER VAPOR LASER. II. Downey, G.D.; Robinson, D.W. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218). J. Chem. Phys. 64: No. 7, 2858-2862 (1 Apr 1976).

Laser emission at 273.03, 262.33, and 590.24 cm^{-1} has been observed from flash photolysis of H_2 and O_3 mixtures, in addition to that at 285.55 cm^{-1}, which was previously reported. All four lines are assigned to laser transitions arising from the $(100)13_{1,12}$– $(010)13_{11,2}$ resonance in H_2O. This lasing has been shown to be pumped by the reaction sequence $O_3 \rightarrow^{h\nu} O(^1D)+O_2(^1\Delta_g)$, (1); $O(^1D)+H_2 \rightarrow OH^\dagger+H$, (2); $H+O_3 \rightarrow OH^\dagger+O_2$, (3); $OH^\dagger+H_2 \rightarrow H_2O^\dagger+H$, (4b), where $H_2O^\dagger$ subsequently emits. The vibrational excitation of $OH^\dagger$ is effective in overcoming the activation energy barrier of Reaction (1b). (auth)

28948 A GIGAWATT CO_2 LASER WITH TELESCOPIC AMPLIFIER. Little, V.I.; Selden, A.C.; Stamatakis, T. (Culham Laboratory, Abingdon, Oxon, OX14 3DB, United Kingdom). J. Appl. Phys. 47: No. 4, 1295-1298 (Apr 1976).

The first production of gigawatt pulses form a 1-m CO_2 telescopic amplifier with megawatt input is reported. This device has been used to generate 1-J pulses of 830 ps FWHM from a suitably gated source. (auth)

28949 APPROXIMATE THEORY OF POWER EXTRACTION FROM A MULTILINE CW GAS-DYNAMIC LASER CAVITY. Brunné, M.; Milewski, J.; Stánco, J.; Zieliński, A. (Institute of Fluid-Flow Machines, Polish Academy of Sciences, Gdańsk, Poland). J. Appl. Phys. 47: No. 4, 1385-1396 (Apr 1976).

Based upon the rate equation formalism the problem of the existence of different longitudinal modes within the active cavity of a cw gas-dynamic laser is considered. The flat parallel mirror cavity supplied with a fast transverse flow of the optically active medium is analyzed. The analytical formulas for the total output power and laser efficiency are given as well as for the single-line output and single-line load coefficients (efficiencies). The CO_2 and/or $CO_2/N_2/H_2O$(He) molecular mixture is kept in mind as a practical analogue for the optically activated medium under consideration. A numerical example concerning a cw gas-dynamic laser driven by benzene combustion in air is presented. (auth)

28950 ELECTRON VELOCITY DISTRIBUTIONS, FRACTIONAL ENERGY TRANSFER, AND COLLISION RATES FOR POTENTIAL Na, NaHe, AND NaXe ELECTRICALLY EXCITED LASER DISCHARGES. Schlie, L.A. (Air Force Weapons Laboratory (AFSC), Kirtland Air Force Base, New Mexico 87117). J. Appl. Phys. 47: No. 4, 1397-1407 (Apr 1976).

The Boltzmann transport equation including elastic, inelastic, ionization, electron-electron, and electron-ion interactions has been numerically solved to determine the electron velocity distribution, the fractional electron energy transfer, and the collision rates for potential Na, NaHe, and NaXe electrically excited laser discharges. Previously reported theoretical and experimental cross-section data from the literature were used in the calculations. Na, like all of the alkali atoms, has a very large cross section ($\sim 4\times10^{-15}$ cm^2) for electronic excitation of the first level (an allowed optical resonant $ns \rightarrow np$ transition). This value greatly exceeds all other low-energy inelastic cross sections for both the Na and the He and/or Xe buffer gases. Such a combination of cross sections enables the input electron energy to be very efficiently transferred to the potential upper laser level, Na(3 *P*). The computed distribution functions are shown to be strongly non-Maxwellian and exhibit an energy variation indicative of this large resonant cross section in Na. Using the electron energy conservation equation reveals that indeed the electronic excitation of the Na first level dominates the electron energy exchange processes for the Na and the Na He/Xe mixtures. For example, in pure Na 100% of the electron energy is transferred to the Na(3 *P*) state in the E/N range 5×10^{-16} to 5×10^{-15} V cm^2. In both the NaHe (1:99) and the NaXe (1:7600) mixtures, over 90% of the electron energy is transferred to this same Na(3 *P*) level in the E/N range of 5×10^{17} to 4×10^{-16} and (1.2–7) $\times10^{-17}$ V cm^2, respectively. At the second Na electronic level, 4*P*, electron energy transfer is down from that of the Na(3 *P*) by nearly three orders of magnitude for all of the mixtures. For the optimum values of E/N as cited above the mean electron energy for the Na, NaHe, and NaXe mixture lies in the range 0.6–1.4, 0.92–2.4, and 1.2–2.7 eV, respectively. Also, the normalized collision rates, ν/N (cm^3 sec^{-1}), for the Na(3 *P*) level are shown to have a value approximately 10–100 times that calculated for the normalized vibrational excitation rates of CO and CO_2 laser discharges. These high pumping rates are a direct result of the large resonant transition cross section and give these systems excellent potential for high-power high-efficiency cw laser operation. Other discharge transport properties, like drift velocities and characteristics energies, are presented. Electron-electron interactions have negligible effects on the "tail" of distribution for partial ionization ratios, n_e/N, values up to 10^{-3} due to the large Na(3 *P*) inelastic cross. The results and their generalizations to all the alkali systems along with recommended cross-section data needed are discussed. (auth)

28951 INTRACAVITY ABSORPTION OF DYE LASERS: A RATE-EQUATION MODEL. Tohma, K. (Radio Research

Laboratories, 4–2–1 Nukui-Kitamachi, Koganei, Tokyo 184, Japan). J. Appl. Phys. 47: No. 4, 1422-1425 (Apr 1976).

Characteristics of cw lasers with intracavity absorption have been discussed by taking account of the spatial relaxation as well as mode competition. A comparison is made with the conventional single-path absorption method, under the same conditions, for estimating the absorption enhancement factor. Weak pumpings, strong mode competition, large spatial relaxation, and wide-band operation bring about tremendous enhancements of absorption. (auth)

28952 LONG-TERM FREQUENCY AND INTENSITY STABILIZATION OF A CW DYE LASER. Abate, J.A. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). J. Appl. Phys. 47: No. 4, 1464-1466 (Apr 1976).

A method to stabilize the output frequency and intensity of a cw dye laser for periods of several hours is described. The dye laser frequency is controlled by a servo system which locks it to a Lamb-dip stabilized He : Ne laser to an accuracy better than 1 MHz with the help of a scanning Fabry-Perot interferometer. The dye laser intensity is controlled to better than 1% by direct control of the pumping source. (auth)

28953 LASING IN A TERNARY MIXTURE OF He-Ne-O_2 AT PRESSURES UP TO 200 TORR. DeYoung, R.J.; Wells, W.E.; Miley, G.H. (Nuclear Engineering Program, University of Illinois, Urbana, Illinois 61801). J. Appl. Phys. 47: No. 4, 1477-1478 (Apr 1976).

Addition of large amounts of helium to the Ne-O_2 8446-Å laser has used the multiple resonances of helium and neon excited states to improve lasing output by a factor of 3. A lower power supply voltage requirement was also obtained and lasing in a mixture of He-Ne-O_2 was found for total pressures well over 200 Torr. Stable pulsed operation for periods of greater than one week are now possible in sealed-off laser cells due to the higher-pressure operation. (auth)

28954 SPECTROSCOPIC PROPERTIES AND LASER PERFORMANCE OF Nd^{3+} IN LANTHANUM BERYLLATE. Jenssen, H.P.; Begley, R.F.; Webb, R.; Morris, R.C. (Allied Chemical Corporation, Morristown, New Jersey 07960). J. Appl. Phys. 47: No. 4, 1496-1500 (Apr 1976).

The neodymium-doped lanthanum beryllate ($La_2Be_2O_5 : Nd^{3+}$ or BEL : Nd) laser crystal is monoclinic, space group C_{2h}^6-C2/c. The fundamental vibration directions of light and the corresponding refractive indices have been determined as a function of wavelength. At 1 μm the indices are $n_X = 1.9641$, $n_Y = 1.9974$, and $n_Z = 2.0348$. The energy levels of Nd^{3+} for the five lowest manifolds are presented. The low concentration limit for the Nd^{3+} $^4F_{3/2}$ fluorescent lifetime in this crystal is 150 μsec and the two observed laser transitions have stimulated emission cross sections of 2.1×10^{-19} cm^2 for $E \| X$ and 1.5×10^{-19} cm^2 for $E \| Y$. The laser wavelengths are 1.070 and 1.079 μm, respectively. In laser testing a higher slope efficiency was obtained in $La_2Be_2O_5 : Nd$ than in $Y_3Al_5O_{12} : Nd$ (YAG : Nd). A Q-switched output of 450 mJ from a 6.4-mm-diam by 76-mm-long X-axis rod of BEL : Nd has been achieved for the 1.079-μm transition, while a YAG : Nd rod of the same size in the same system yielded 160 mJ. The higher Q-switched output in BEL : Nd is consistent with the lower stimulated emission cross sections as compared to that of YAG : Nd. (auth)

28955 NARROW-BEAM FIVE-LAYER (GaAl)As/GaAs HETEROSTRUCTURE LASERS WITH LOW THRESHOLD AND HIGH PEAK POWER. Thompson, G.H.B.; Henshall, G.D.; Whiteaway, J.E.A.; Kirkby, P.A. (Materials and Components Laboratory, Standard Telecommunication Laboratories Limited, London Road, Harlow, Essex, England CM17 9NA). J. Appl. Phys. 47: No. 4, 1501-1514 (Apr 1976).

A variety of (GaAl)As/GaAs heterostructure injection lasers have been fabricated with two pairs of heterojunctions, the inner pair for carrier confinement and the outer pair for optical confinement. Asymmetrical versions of this design have given, at one extreme, threshold current density J_t at 300 K as low as 500 A/cm^2 and at the other extreme far-field angular beam widths to the half-power point of 15° with $J_t < 1000$ A/cm^2, for 500-μm-long sawn cavity lasers with reflectors on one face. The incremental quantum efficiency from one end of 300-μm-long lasers with reflectors was over 40%. The peak optical power from lasers of 100 μm width was up to 3 W for 200-ns pulses. The temperature variation of threshold over the range 290–355 K was $J_t^{355}/J_t^{290} \sim 1.5$. Double-heterostructure lasers with narrow active layers and 20% AlAs confinement steps gave almost comparable performance in J_t and beam width (650 A/cm^2 for 33° and 1200 A/cm^2 for 15°), but the linearity of light versus current was poorer, the temperature sensitivity of threshold was $J_t^{355}/J_t^{290} \geq 2$, and efficiency also dropped with temperature. The optical distribution has been calculated for various multilayer heterostructure waveguides and related both to the far-field beam width and to the threshold current. A universal gain/current density relation for the active layer has been deduced from the measurements and agrees reasonably with published theory. (auth)

28956 OPTICALLY PUMPED SUPERFLUORESCENT Na_2 MOLECULAR LASER. Henesian, M.A.; Herbst, R.L.; Byer, R.L. (Microwave Laboratory, W. W. Hansen Laboratories of Physics, Stanford University, Stanford, California). J. Appl. Phys. 47: No. 4, 1515-1518 (Apr 1976).

We have optically pumped an Na_2 molecule at 0.473 and 0.659 μm and obtained superfluorescent laser emission on a series of green and yellow molecular B-X-band transitions and laser oscillation in the near infrared on A-X-band transitions. Pump saturation, laser gain, and laser saturation intensity are reported. (auth)

28957 Nd-GLASS THIN-FILM WAVEGUIDE: AN ACTIVE MEDIUM FOR Nd THIN-FILM LASER. Chen, B.; Tang, C. L. (Cornell University, Ithaca, New York 14853). Appl. Phys. Lett.; 28: No. 8, 435-437(15 Apr 1976).

We report the optical properties, fluorescence lifetime, and method of fabrication of very low-loss and high-optical-quality Nd-glass thin films. Substantial optical gain due to stimulated emission in such thin films is obtained. (AIP)

28958 TIME-RESOLVED PUMP DEPLETION IN n-InSb RAMAN SPIN-FLIP LASER. Cantrell, C.D.; Figueira, J.F.; Scott, J.F.; Scully, M.O. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). Appl. Phys. Lett. 28: No. 8, 442-444 (15 Apr 1976).

Analysis of the transient depletion of a 10.6-μm laser beam in n-InSb at 2 K observed by Figueira, Cantrell, Rink, and Forman shows that the observed depletion is not due to causes such as lattice heating, depletion by other nonlinear processes, or optical damage. Simple estimates are presented which show that a 10.6-μm laser pulse of the intensity and duration of that used by Figueira *et al.* will heat the conduction electrons very strongly, leading to a transient increase in carrier concentration and conductivity, and a corresponding increase in optical absorption. (auth)

28959 BORON FLUORIDE AND ALUMINUM FLUORIDE INFRARED LASERS FROM QUASICONTINUOUS SUPERSONIC MIXING FLAMES. Rice, W.W.; Beattie, W.H.; Oldenborg, R.C. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545); Johnson, S.E.; Scott, P.B. Appl. Phys. Lett. 28: No. 8, 444-446 (15 Apr 1976).

Laser action has been observed from the chemical reaction of fluorine injected into supersonic flows of boron and aluminum atoms. The laser output in the 12.8–20-μm region (AlF) is temporally different from that in the 6.1–13-μm region (BF), but both have pulse durations 10^3–10^4 longer than any of the previously reported metal atom oxidation lasers. (auth)

28960 CONTINUOUS ROOM-TEMPERATURE OPERATION OF GaAs-$Al_xGa_{1-x}As$ DOUBLE-HETEROSTRUCTURE LASERS PREPARED BY MOLECULAR-BEAM EPITAXY. Cho, A.Y.; Dixon, R.W.; Casey, H.C. Jr.; Hartman, R.L. (Bell Laboratories, Murray Hill, New Jersey 07974). Appl. Phys. Lett. 28: No. 9, 501-503 (1 May 1976).

The continuous (cw) operation at temperatures as high as 100 °C of stripe-geometry GaAs-$Al_xGa_{1-x}As$ double-heterostructure lasers fabricated by molecular-beam epitaxial (MBE) techniques has been achieved. Improved MBE laser performance was the result of the extensive efforts to eliminate hydrocarbon and water vapor from the growth apparatus. For 12-μm-wide stripe-geometry lasers with 380-μm-long cavities, the cw threshold currents varied between 163 and 297 mA at room temperature. (auth)

28961 DIRECT NUCLEAR PUMPING OF A Ne-N_2 LASER. DeYoung, R.J.; Wells, W.E.; Miley, G.H.; Verdeyen, J.T. (Nuclear Engineering Program and Electrical Engineering Department, University of Illinois, Urbana, Illinois 61801). Appl. Phys. Lett. 28: No. 9, 519-521 (1 May 1976).

Direct nuclear pumping of a Ne-N_2 laser has been achieved with simultaneous output at two wavelengths (8629 and 9393 Å) in atomic nitrogen. Pumping was achieved through bombardment of the gas by MeV ions generated when neutrons from a TRIGA reactor interact with a boron-10 coating on the inner wall of the laser cell. Pressure, concentration, threshold, and other parameters are presented. (auth)

28962 FAST-DISCHARGE-INITIATED KrF LASER. Sutton, D.G.; Suchard, S.N.; Gibb, O.L.; Wang, C.P. (The Aerospace Corporation, El Segundo, California 90245). Appl. Phys. Lett. 28: No. 9, 522-523 (1 May 1976).

Intense laser emission has been observed from the KrF molecule formed by a chemical reaction initiated by a fast discharge. With a gas mixture of He:Kr:NF_3 = 500:50:1 and a sample pressure of 700 Torr, an output energy of 0.8 mJ was measured from a 25-nsec laser pulse (FWHM). Spectral analysis of the laser emission indicated laser action at 248.5 and 249.5 nm. (auth)

28963 LASER ACTION AT 12.812 μM IN OPTICALLY PUMPED NH_3. Chang, T.Y.; McGee, J.D. (Bell Telephone Laboratories, Holmdel, New Jersey 07733). Appl. Phys. Lett. 28: No. 9, 526-528 (1 May 1976).

Optical pumping of the aR (6,0) line of the ν_2 fundamental vibrational band of NH_3 has led to laser action on the aP (8,0) line at 12.812 μm of the same vibrational band. A 5-kW pulsed output has been obtained by using 1.5 MW of pump power at 9.294 μm from a CO_2 laser. (auth)

28964 LASER OSCILLATION ON THE 292-nm BAND SYSTEM OF Br_2. Murray, J.R.; Swingle, J.C.; Turner, C.E. Jr. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). Appl. Phys. Lett. 28: No. 9, 530-531 (1 May 1976).

Laser oscillation has been observed on numerous rotational transitions of the most intense bands of the Br_2 emission system near 292 nm. The laser is electron-beam excited in an Ar-Br_2 mixture. Quenching of the lower level by Br_2 is inferred. (auth)

28965 EXCITATION OF POLYATOMIC MOLECULES IN VAPOR PHASE BY NOBLE-GAS METASTABLE ATOMS. Sakurai, T.; Littlewood, I.M.; Webb, C.E. (Clarendon Laboratory, Parks Road, Oxford, England). Appl. Phys. Lett. 28: No. 9, 533-535 (1 May 1976).

The fluorescence spectra originating from the first excited singlet states of the vapor phase dyes perylene and POPOP have been observed in a flowing noble-gas afterglow. Excitation has been shown to follow energy transfer from noble-gas metastable atoms to the dye molecule. (auth)

28966 THERMAL MODIFICATION OF THE KINETIC SEQUENCE PUMPING THE HELIUM-NITROGEN CHARGE-TRANSFER LASER. Collins, C.B.; Carroll, J.M.; Lee, F.W.; Cunningham, A.J. (The University of Texas at Dallas, Box 688, Richardson, Texas 75080). Appl. Phys. Lett. 28: No. 9, 535-537 (1 May 1976).

An increased output energy of 5 J/l at 427.8 nm has been obtained with 3.2% efficiency from the helium-nitrogen charge-transfer laser through the thermal modification of the kinetic sequence pumping the inversion. A decrease in gas temperature of 40°C has been sufficient to increase output pulse energies by a factor of 2 for high currents of the electron beam discharge and by as much as a factor of 20 at lower currents. These results have necessitated a revision of the pumping sequence to include charge transfer from the ion aggregate, He^+_3. The new kinetic model is sufficient to predict the effects of thermal modification, as well as the strong nonlinear dependence of laser output on pressure which had been previously reported. It indicates that the theoretical limit on efficiency 6.10% may best be approached through proper choice of the gas temperature. (auth)

28967 CONTINUOUSLY TUNABLE MULTIATMOSPHERE N_2O AND CS_2 LASERS. O'Neill, F.; Whitney, W.T. (Laser Physics Branch, Optical Sciences Division, Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 28: No. 9, 539-541 (1 May 1976).

We describe the operating characteristics of pulsed multiatmosphere electron-beam-controlled He:CO:N_2O and He:CO:CS_2 lasers. Continuous interferometric tuning of these lasers has been achieved giving a tunable linewidth of <0.1 cm^{-1} for a laser pulse energy of 115 mJ from N_2O and 45 mJ from CS_2. (auth)

28968 DOUBLE-HETEROSTRUCTURE PbSnTe LASERS GROWN BY MOLECULAR-BEAM EPITAXY WITH cw OPERATION UP TO 114 K. Walpole, J.N.; Calawa, A.R.; Harman, T.C.; Groves, S.H. (Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Massachusetts 02173). Appl. Phys. Lett. 28: No. 9, 552-554 (1 May 1976).

Double-heterostructure $Pb_{1-x}Sn_xTe$ lasers with active regions of $Pb_{0.782}Sn_{0.218}Te$ have been grown by molecular-beam epitaxy which operate cw up to heat-sink temperatures of 114 K. Temperature tuning of the emission from 15.9 to 8.54 μm wavelength is obtained, with emission at 77 K near 11.5 μm. The current-voltage characteristics show an abrupt change in slope at threshold, indicating high incremental internal quantum efficiency. (auth)

28969 ATTACHMENT-DOMINATED ELECTRON-BEAM-IONIZED DISCHARGES. Daugherty, J.D.; Mangano, J.A.; Jacob, J.H. (Avco Everett Research Laboratory, Incorporated, Everett, Massachusetts 02149). Appl. Phys. Lett. 28: No. 10, 581-583 (15 May 1976).

In this letter we derive the stability criterion in discharges where two-step ionization is dominant. For stable equilibrium the attachment rate has to be greater than or equal to *twice* the ionization rate. Two-step ionization is often dominant in discharge-pumped visible lasers because of the relatively large number of electronically excited states. Analysis of the KrF laser discharge indicates that two-step ionization is dominant. (auth)

28970 GaAs-$Ga_{1-x}Al_xAs$ DOUBLE-HETEROSTRUCTURE INJECTION LASERS WITH DISTRIBUTED BRAGG REFLECTORS. Tsang, W.; Wang, S. (Department of Electrical Engineering and Computer Sciences, and the Electronics Research Laboratory, University of California, Berkeley, California 94720). Appl. Phys. Lett. 28: No. 10, 596-598 (15 May 1976).

Laser oscillation in injection-pumped GaAs-$Ga_{1-x}Al_xAs$ double-heterostructure distributed Bragg reflector (DBR) lasers is reported. Current threshold density as low as 890 A/cm^2 in pulsed operation has been obtained at 183 °K. In this laser diode, the corrugations are placed outside the active part of the laser in the form of an end pair of parallel Bragg reflectors. The observed characteristics of the DBR lasers are found to agree well with the theory. (auth)

28971 RED-LIGHT-EMITTING LASER DIODES OPERATING cw AT ROOM TEMPERATURE. Kressel, H.; Hawrylo, F.Z. (RCA Laboratories, Princeton, New Jersey 08540). Appl. Phys. Lett. 28: No. 10, 598-600 (15 May 1976).

Heterojunction laser diodes of AlGaAs have been prepared with threshold current densities substantially below those previously achieved at room temperature in the 7200–8000-Å spectral range. These devices operate cw with simple oxide-isolated stripe contacts to 7400 Å, which extends cw operation for the first time into the visible (red) portion of the spectrum. (auth)

28972 XeBr EXCIPLEX LASER. Searles, S.K. (Laser Physics Branch, Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 28: No. 10, 602-603 (15 May 1976).

Laser emission from the recently discovered XeBr exciplex laser was investigated as a function of the partial pressures of Xe and Br_2. An optical loss process appears to limit high-pressure operation. (auth)

28973 SPIN-FLIP RAMAN LASER AT WAVELENGTHS UP TO 16.8 μM. Patel, C.K.N.; Chang, T.Y.; Nguyen, V.T. (Bell Telephone Laboratories, Holmdel, New Jersey 07733). Appl. Phys. Lett. 28: No. 10, 603-605 (15 May 1976).

An InSb spin-flip Raman (SFR) laser is pumped with an optically pumped NH_3 laser line at 780.515 cm^{-1} to obtain tunable first Stokes laser radiation at wavelengths up to 16.8 μm. We report results on the power output, tunability, and preliminary spectroscopy of UF_6. Scaling of the primary CO_2 pump laser as well as the NH_3 laser together with the SFR laser appears possible for potential application of this system to uranium isotope separation. (auth)

28974 cw BRILLOUIN LASER. Hill, K.O.; Kawasaki, B.S.; Johnson, D.C. (Department of Communications, Communications Research Centre, Ottawa, Canada K2H 8S2). Appl. Phys. Lett. 28: No. 10, 608-609 (15 May 1976).

The observation of efficient continuous-wave Brillouin laser action in an optical-fiber ring resonator is reported. Internal laser conversion efficiencies of 50% and a Brillouin-shifted output of 20 mW have been achieved. (auth)

28975 TEMPORAL STABILITY OF UNSTABLE RESONATOR WITH CROSSFLOW. Mirels, H. (The Aerospace Corporation, El Segundo, California 90256). Appl. Phys. Lett. 28: No. 10, 612-613 (15 May 1976).

The temporal stability of the output from a cw laser that contains an unstable resonator with crossflow is investigated for cases where the population inversion is partially due to a pumping mechanism within the resonator. For resonator magnification M near 1, the output is shown to be stable when $G_0(1) < 1$ and $dP/d\zeta \geq 0$, where $G_0(1)$ is the ratio of inlet to optical axis gain, and $(-dP/d\zeta)$ is the steamwise gradient of the volumetric pumping. For arbitrary M and $\phi \gg 1$, laser output fluctuations are at most of order ϕ^{-1}, where ϕ is a measure of the net gain due to pumping divided by the threshold gain. (auth)

28976 THEORY OF POROUS WALL CAPILLARY TUBES FOR FLOWING GAS LASERS. Papayoanou, A.; Fujisawa, A. (Army Electronics Command Labs., Fort Monmouth, NJ). IEEE J. Quant. Electron.; QE-11: No. 8, 579-583(Aug 1975).

Flowing gas capillary lasers exhibit high optical gains. However, as a result of the linear axial pressure variation in the tube bore, gain and saturation intensities are not axially uniform. This pressure variation can be reduced by introducing the gas into the tube bore through the walls of a porous capillary tube. Analysis of the gas flow shows that the axial pressure variation in the porous wall tubes is more gradual than for dense wall tubes leading to more uniform gain conditions. The saturation intensity is more uniform not only due to the reduced pressure anisotropy but also, at higher flow rates, because of axially varying particle dwell times in the discharge region.

28977 CONTINUOUS FLOW COMBUSTION LASERS. A Review. Bronfin, B. R. (United Aircraft Research Labs., East Hartford, CT). pp 935-950 of Fifteenth International Symposium on Combustion. Pittsburgh; Combustion Inst. (1975).

From 15th international symposium on combustion; Tokyo, Japan (25 Aug 1974).

The operating principles, the development, and the present state of two major classes of continuous flow combustion driven

lasers—gas dynamic lasers (GDL) and chemical mixing laser (CML), are reviewed. In these devices, gas-phase combustion reactions continuously pump high-power infrared laser emission on vibrational-rotational transitions of molecular species formed by exothermic combustion reactions. In GDL devices, pumping of the laser emission proceeds through thermal equilibrium followed by sudden aerodynamic expansion to yield vibrational-state population inversions. In CML devices, pumping proceeds through direct generation of population inversions among vibrational states in the product molecules of nonequilibrium gas-phase elementary exothermic chemical reactions. A description of key kinetic processes and operating mechanisms in CML devices is given.

28978 INDIUM GALLIUM PHOSPHIDE ARSENIDE–GALLIUM ARSENIDE PHOSPHIDE SINGLE HETEROJUNCTION LASERS. Coleman, J. J. Urbana, IL; Univ. of Illinois (1975). 105p. University Microfilms Order No. 76-6730.

Thesis (Ph. D.).

The quaternary alloy InGaPAs has been grown by liquid phase epitaxy on GaAsP substrates forming for the first time high quality single heterojunction laser diodes on GaAsP. Unique high energy laser data have been obtained by employing the LPE quaternary as a low-index, wide-gap epitaxial layer on a previously grown VPE ternary substrate. New insight into the effect of the N isoelectronic trap has been gained by forming otherwise-identical heterojunctions on N-doped and N-free GaAs/sub 1-x/ P/sub x/ substrates with crystal compositions in the direct range (x less than x/sub c/ approximately 0.46, 77°K).

28979 CARBON DIOXIDE GAS LASER WITH NUCLEAR PUMPING. Pustavalov, A. A.; Smirnov, B. M. Dokl. Akad. Nauk SSSR; 222: No. 3, 583-586(21 May 1975). (In Russian)

The construction of a gas laser is considered in which the walls of a tube 1 m long and 1 cm in dia are covered with radioactive promethium having an electron energy of ~60 keV. Grids are installed to reduce the energy of the secondary scattered electrons to ~1 keV and to obtain an electron multiplication factor on the order of 100. Experimental data show that in nitrogen the electron energy is expended on excitation of oscillatory levels of the molecule over a wider region of energies than in carbon dioxide gas. Since the excitation energy of the oscillatory level of the nitrogen molecule is close to the excitation energy of the upper oscillatory level of the carbon dioxide molecule, the oscillatory excitation of the nitrogen molecule is readily transmitted to the carbon dioxide molecule. Analysis shows that the density of nitrogen should be $\sim 10^{16}$ cm^{-3} and that the density of carbon dioxide gas should be $\sim 10^{15}$ cm^{-3}. In a similar manner it is also possible to create a helium-neon laser. The radioactive source must supply an energy flux $q = 10^{-4}$ W/cm^2. An energy conversion efficiency of 10% is assumed. In view of its low power this laser is compact and may find various uses. (SJR)

28980 NARROW-BAND, SINGLE-PULSE, RUBY LASER WITH A RING RESONATOR. Lavrovskii, L. A.; Morgun, Yu. F.; Muravitskii, M. A. Zh. Prikl. Spektrosk.; 23: No. 4, 609-616(Oct 1975). (In Russian)

An experimental study was carried out, both at the exit and at various points of the resonator, of the simultaneous properties and characteristics of time energy and spectra of two light waves from a ruby laser having a three-mirror ring resonator. This laser generates large pulses with a spectral width of 30 Mhz at an energy of 0.5 J. In order to create a mode of a single-direction generation in any direction, use is made of an optical wedge placed at different points of the resonator with respect to the active elements and the exit mirror. A presentation is given of experimental values of the radiation parameters and of the suppression of colliding waves in five resonators. In recording radiation spectra, use is made of interferometers having a base of 1 m. As a result of the studies which were carried out, single pulses were obtained having a spectral radiation width of 10^{-3} cm^{-1} (30 MHz) at an energy of 0.4 to 0.6 J. (SJR)

28981 NOISE SUPPRESSION OF A SINGLE-FREQUENCY, RETUNABLE He–Ne LASER. Im Tkhek-de; Timofeev, V. P. Zh. Prikl. Spektrosk.; 23: No. 4, 624-628(Oct 1975). (In Russian)

An experimental study was made of the efficiency of suppressing particular noises in a He-Ne laser with $\lambda = 0.63$ μm, which are associated with the unstability of pumping a glow discharge in a plasma during a change in the geometry of the discharge channel. A look was taken at gas-discharge tubes consisting of a set of short capillaries connected to each other with spherical-shaped cavities of relatively large diameter. A determination was made of the threshold of various plasma fluctuations, a knowledge of which is necessary in constructing single-frequency retunable lasers having a low noise level and a high increase over the generation threshold. It is shown that under discharge conditions typical for He-Ne lasers, plasma fluctuations decrease by a factor of more than 300, and the particular laser noises caused by instability of pumping become unsubstantial. (SJR)

28982 EFFECT OF SLOWLY ESTABLISHING GENERATION IN AN IONIC ARGON LASER. Karteleva, S. S.; Zaroslova, O. S.; Grin, L. E. Zh. Prikl. Spektrosk.; 23: No. 4, 629-632(Oct 1975). (In Russian)

A slow process of establishing steady-state power generation having a duration of a number of seconds was observed in an Ar^+ laser. It is shown that the character of the slow change in power (decrease or increase) depends on the quality of resonator tuning and on the power of the line which is being generated (the effect is great for the power line 488 nm and weak for the line 514.5 nm). In studies of competition in the 488 nm and 514.5 nm lines of an Ar^+ laser the slow process of establishing generation is imposed on a fast change in competition, and may coincide or be opposite to this change depending on the quality of resonator tuning. Observations of the spectrum of the single-frequency generation of an Ar^+ laser showed that during establishment of the steady-state power of generation a decrease takes place in the length of the Foks-Smith resonator approximately by $\lambda/25$ because of thermal deformation (protruding) of the mirror. It is concluded that the thermal effects on the mirrors are responsible for the slow changes in power during establishment of a steady-state mode of generation. (SJR)

28983 SINGLE-PULSE, FREQUENCY, RUBY LASER "IMPUL'S-3". Andreichev, V. A.; Boiko, B. B.; Korochkin, L. S.; Mikhnov, S. A. Zh. Prikl. Spektrosk.; 23: No. 4, 741-744(Oct 1975). (In Russian)

A discussion is given of the optical arrangement in a single-pulse ruby laser with a passive shutter made of glass KS-19, which operates in a mode of repeating pulses. The main feature of the arrangement is the presence of an optical system with a variable focal distance in the resonator of the laser. A brief description of the characteristics is given for a model of the unit "Impul's-3" operating as described. (SJR)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 30435 and 31619.

28984 PROPERTIES OF A WEAKLY COUPLED SUPERCONDUCTING RING AS AN ELEMENT WITH SEVERAL STABLE STATES. Likharev, K. K. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 7, 109-116(Jul 1974).

Translated from Radiotekh. Elektron.; 17: No. 7, 1494-1502 (Jul 1974).

The properties of a superconducting ring, closed by a weak contact with low capacitance, were investigated. These properties are important when such a system is used as an element in computers. An example is given of the selection of the parameters of this element, and its characteristics are evaluated.

28985 SUPERCONDUCTING "WEAK LINK" WITH BISTABLE-MEMORY PROPERTIES. Cuomo, J. J.; Harris, E. P.; Rutz, R. F. IBM Tech. Disclosure Bull.; 17: No. 4, 1238-1239(Sep 1974).

Bistable switches with memory properties, such as that made of Si–AlN–W, when switched to an on or low-resistance state less than about 1000 ohms, become superconductors below a certain critical temperature. Substrate materials Nb and W were used in devices with top contacts of Si, Al, SiC, and various alloys of Si with Al and Si with Ge. Devices of this type were observed to display the ac Josephson effect. Thus the device contains a weak link, ruggedly embedded in a dielectric film, and the properties of the link can be adjusted electrically.

28986 FAULT RECOVERY PERFORMANCE OF A HELIUM-INSULATED RIGID AC SUPERCONDUCTING CABLE. Meyerhoff, R. W. (Union Carbide Corp., Tarrytown, NY). IEEE Trans. Power Appar. Syst.; PAS-94: No. 5, 1734-1741(1975).

From IEEE PES winter meeting; New York, NY, USA (26 Jan 1975).

If a through fault causes overheating of a superconducting cable, the cable cannot be used until the normal operating temperature is re-established. Since this could take more than a day, the cable must be designed so that the largest through fault expected will not overheat the cable system. A description is given of: (1) a theoretical analysis of the behavior of a rigid coaxial ac superconducting cable system during and following a through fault; and (2) a theoretical and experimental verification of the ability of this design to continue to deliver power following a through fault. (auth)

28987 METALLURGICAL CONSIDERATIONS WITH RESPECT TO ELECTRODES AND INTERCONNECTION LINES FOR JOSEPHSON TUNNELING CIRCUITS. Lahiri, S.K. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Vac. Sci. Technol. 13: No. 1, 148-151 (Jan 1976).

A description is presented of the composition, structure, and thermal stability of the Pb-alloy films which were used in the process described by Greiner *et al.* for fabricating experimental Josephson tunneling circuits. The films were used to form tunneling-junction electrodes, controls, and interconnection lines; they consisted of Pb with In and/or Au additions. Both of the additions were used for the base electrodes, controls, and interconnection lines whereas only Au was added in the case of the counterelectrodes. Each contained an intermetallic compound, which was believed to cause some mechanical strengthening. The base electrodes, controls, and interconnection lines contained, in addition, a Pb–In solid solution phase. Tunneling junctions and gates which were fabricated through use of the indicated types of Pb-alloy films displayed characteristics which were suitable for circuit operation. (auth)

28988 FURTHER STUDIES ON THE TWO-LEVEL-ATOM PICTURE OF THE JOSEPHSON EFFECT. Rogovin, D. (Department of Physics and Optical Sciences Center, University of Arizona, Tucson, Arizona 85721). Phys. Rev. B 13: No. 5, 1980-1992 (1 Mar 1976).

We demonstrate that the two-level atomic picture of the Josephson effect is valid for realistic tunneling models. In addition, we extend the analogy between two-level quantum systems and Josephson junctions to include stimulated emission and absorption processes. (auth)

28989 CALCULATION OF THE MAGNETIC FIELD AND WINDING INDUCTIVITIES OF A TURBOGENERATOR WITH A SUPERCONDUCTING FIELD WINDING. Sergl, J. (Tech Univ., Munich, Ger.). Arch. Elektrotech. (Berlin); 56: No. 4, 180-188 (Oct 1974). (In German with English Abstract).

A characteristic feature of the turbogenerator with superconducting field winding is the predominant use of nonmagnetic materials in the magnetic circuit. To obtain a basic insight concerning the operating characteristics of such a generator, clear field equations for radially infinite thin current sheets are derived under the simplified assumption that the machine is infinitely long, has a perfect damper winding, and is radially surrounded by an ideal magnetic screen. The calculation of the field is followed by the calculation of the characteristic inductivities and reactances. In conclusion, the recording of the vector diagram is discussed. (auth)

28990 DETERMINATION OF THE FLOW RATE OF THE REFRIGERANT FOR THERMOSTATIC CONTROL OF THE WINDINGS OF CRYOELECTROMACHINES. Verkin, B. I.; Zhitomirskii, I. S. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 5, 102-108(Sep-Oct 1974). (In Russian).

A formula is derived for the determination of heat addition to the zone of cryostatic control from a structural element cooled by departing vapors. This element has no internal heat sources or lateral heat addition. Formulas for the corresponding flow rate of the refrigerant are also presented. A model of ideal heat exchange, taking account of the dependence of the main thermophysical characteristics on temperature, is utilized. For the case of a dynamic shaft, a dependence of the flow rate of the refrigerant on the capacity supplied, frequency of rotation, and other parameters is obtained. A formula is deduced for a correction to the magnitude of the flow rate of the refrigerant connected with nonideal heat exchange. (auth)

28991 THEORETICAL ANALYSIS OF THE DISCHARGE OF A SUPERCONDUCTING INDUCTIVE ACCUMULATOR UPON A PARALLEL INVERTER. Bertinov, A. I.; Ionova, A. S.; Manuilov, V. G. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 5, 151-153 (Sep-Oct 1974). (In Russian).

A system consisting of an inductance L storing energy from a primary source, a parallel inverter connected with the inductance, and an active load R connected to the inverter is considered. The work of the system begins from the moment of disconnection of the source u. The process of discharge can be subdivided into a series of half-periods. Equations for the discharge process are obtained and solved. Nomograms are constructed for the determination of the parameters of the accumulator and the inverter, taking into account harmonization of their characteristics. (auth)

28992 SELF-RESETTING LOGIC CIRCUIT. Herrell, D. J.; Zappe, H. H. IBM Tech. Disclosure Bull.; 17: No. 4, 1204-1205 (Sep 1974).

A logic circuit employing a Josephson tunnelling device is considered. Circuits are developed which, when connected to the Josephson device, enable it to be self-resetting without consequent reduction of overall speed and tolerance. (auth)

28993 NONLATCHING JOSEPHSON JUNCTION LOGIC DEVICE. Schlig, E. E.; Zappe, H. H. IBM Tech. Disclosure Bull.; 17: No. 4, 1222-1223(Sep 1974).

The inherent hysteresis of the voltage state of Josephson junctions requires that a Josephson junction logic circuit must be reset into the zero-voltage state after each function of a logic block. Ideally, it would be desirable to use a circuit which develops a voltage (sending current into the logic line) as long as the control field, which results from a linear superposition of the control currents, exceeds a given threshold. As soon as the control field decreases below this threshold, the voltage would vanish. There is an important additional requirement, which is that the output voltage be well defined and essentially unaffected by variations of the circuit parameters. It is shown how such a circuit can be built with Josephson junctions. (auth)

28994 ANALOG-TO-DIGITAL CONVERTER USING JOSEPHSON TUNNELING CIRCUITS. Anacker, W. IBM Tech. Disclosure Bull.; 17: No. 4, 1237-1237A(Sep 1974).

An analog-to-digital converter with Josephson tunneling gates is described. An advantage of the converter is that its accuracy is determined solely by a passive inductance network providing the required bias currents and by another current which can be supplied and regulated internally or externally. (auth)

28995 PROCESS FOR PRODUCTION OF VERY PURE ALUMINUM FOR CRYOGENIC ENGINEERING APPLICATIONS, PARTICULARLY FOR CRYOELECTRIC MAGNETS. Hanniball, W. D.; Ibe, G.; Kurre, K.; Peychal–Heiling, H.; Pfundt, H.; Reuter, W.; Scharf, G.; Winkhaus, G. (Ver Alum–Werke, Bonn, Ger.). Bundesminist. Forsch. Technol. Forschungsber. Technol. Forsch. Entwickl.; (In German with English abstract).

In a pilot plant (capacity 1 to 2 tons Al per year) which was designed on the basis of former laboratory experience, high aluminum purity grades were obtained. It was possible to work the refined material into thin strip without considerable loss of purity. Experiments to insulate the strip by anodic oxidation, to join strip pieces by electron beam welding, and to produce thin wire from high purity aluminum were successfully performed. The feasibility of the production of fabricated high purity aluminum on a technical scale and consequently the availability of the high purity metal for future applications was demonstrated. (auth)

28996 CRYOGENICS: ENERGY TRANSMISSION OF THE FUTURE. Anon. Verfahrenstechnik (Mainz); 8: No. 10, 281(Oct 1974). (In German).

The design of a low-temperature electric cable is described. The cable consists of Cu–Nb–Sn wires, cooled with liquid He to an operating temperature of -267^{0}C, and will transmit power of 2000 MW. (12,000 amp, 200 kV-dc). (auth)

28997 MISSING LINK FOR THE SUPERCONDUCTING COMPUTER. Deutscher, G. (Tel Aviv Univ., Israel). New Sci.; 69: No. 990, 491-493(4 Mar 1976).

There's a trade-off point for all electrical machines as they become bigger and more powerful when it pays to go superconducting. This is as true for big computers as electric motors and generating sets. Why the superconducting computer hasn't arrived yet is because the basic component needed, the superfast Josephson junction, is notoriously fragile and difficult to fabricate.

28998 STABILIZING SUPERCONDUCTORS FOR POWER ENGINEERING APPLICATIONS. Hoffer, J. K.; Kerr, E. C.; Laquer, H. L. (Los Alamos Scientific Lab., NM). IEEE Trans. Power Appar. Syst.; PAS-94: No. 6, 2008-2014(1975).

From IEEE PES Summer meeting; San Francisco, CA, USA (20 Jul 1975).

Exhibiting essentially zero resistivity at high current densities and large magnetic fields, modern superconducting materials offer intriguing possibilities in power engineering. However, in order to utilize this property in any large scale application, the superconductor must be stable during fault and overload transients in the total system. In order to know whether the superconductor itself is stable, one must understand and control the detailed mechanisms of magnetic flux motion which occur in the material. Such flux motion will give rise to a non-zero resistivity and hence will always involve heat generation, which in turn will perturb the low temperature environment necessary to sustain superconductivity. A discussion is given of the essential differences between superconductors and ordinary conductors; the control of heat generation resulting from magnetic flux motion necessary to insure that the superconductor is stable; and some experiments on models of dc superconducting transmission cables which test the theoretical assumptions.

28999 MAGNETIC STABILIZATION OF THE OPERATING POINT FOR THE SUPERCONDUCTIVE BOLOMETER. Zaytsev, G. A.; Stashkov, V. G.; Khrebtov, I. A. Prib. Tekh. Eksp.; No. 5, 210-211(1975). (In Russian).

The threshold sensitivity of bolometers is limited by the fact that their resistance at the operating point varies with the temperature in the cryostat. A device is described which was designed to improve the stability of the operating point by automatically controlled heating. It uses magnetic control of the

resistance in the superconductive bolometer, and the stabilization is based on the temperature of the superconductor transition as a function of the magnetic field intensity. Curves are plotted of the Sn–Pb superconductive bolometer resistance as functions of the temperature, the bias current, and the magnetic field. A schematic of the stabilization system, which uses field-effect and pnp transistors, is also shown. The bolometer itself is in the form of a dc bridge, with the output diagonal providing a signal proportional to the oscillations of the liquid He temperature in the cryostat containing the sensitive element of the bolometer. This output signal is then applied to the input of a phase-sensitive dc amplifier. The load of this amplifier is the winding of the solenoid in which the bolometer is placed. This stabilization circuit was also tested with a vacuum superconductive bolometer. (JPRS)

29000 SUPERCONDUCTING CABLE IN TEST. Heumann, H.; Koetzold, B. (AEG-Telefunken, Frankfurt am Main). Umsch. Wiss. Tech.; 74: No. 4, 123-124(15 Feb 1974).

A superconducting flexible dc cable is described which is suitable for 5000-MW load, e.g., for the bulk power supply of a city center in the end of the 1980's. The cable was tested in a closed circuit of 15 m extension up to 30,000 amps. After optimizing the cable layout, field tests will start at 1979. (Electr. Electron Abstr.)

29001 SUPERCONDUCTING AND RESISTIVE CRYOGENIC POWER TRANSMISSION RESEARCH IN THE U. S. An Opportunity for Cryogenic Innovation. Belanger, B. C. (Atomic Energy Commission, Washington, DC). pp 1-22 of Advances in Cryogenic Engineering. Volume 20. New York; Plenum Press (1975).

From cryogenic engineering conference; Atlanta, Georgia (USA) (8 Aug 1973).

A general review of the state of the art of superconducting and cryoresistive power transmission is presented and several research and development problems in low-temperature cable systems identified. The basic concepts of two resistive cryogenic cable systems and two superconducting cable designs under study are discussed, and directions in future testing and research on these systems are indicated. Concepts of refrigeration schemes are outlined, and refrigeration cost considerations are aired. The cable systems examined are all ac systems, though they could be adapted to dc. At least one of them offers a more efficient means of transmitting power underground than conventional alternatives.

29002 PROBLEMS IN HEAVY DUTY GENERATOR CONSTRUCTION CONNECTED WITH THE USE OF SUPERCONDUCTIVITY. Glebov, I. A.; Danilevich, Ya. B. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 3, 3-10(1975). (In Russian).

The use of superconducting field windings in turbogenerators increases the magnetic induction, lowers generator weight, and increases power and efficiency. The features of the largest of such generators, are diagramed and described and are compared to those of the Westinghouse cryoturbogenerator. Generators being planned and designed are also presented. Due to losses which hinder regulation, slow oscillation damping, and increased length of the transitional regime, it is more expedient to use slow-acting current regulation with turbine moment regulation. Constructional problems for these generators include the choice of rotor thermal system and hydrodynamics optimization of cooling helium vapor flow. (JPRS)

29003 REGULATED POWER SUPPLY FOR A SUPERCONDUCTING MAGNET. Shor, M. Ya. (All-Union Scientific Research Inst. for Physical Mechanics and Radio Measurements, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1191-1192(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 148-149(1975).

An economical compact power supply for a superconducting magnet is described; the current may be regulated from 0 to 300 Å, with an instability not exceeding 10^{-6} at 300 A. For a magnet inductance of 1 H the ripple factor does not exceed 10^{-7}. No more than 550 W of power is drawn.

29004 PROPERTIES OF A JOSEPHSON TRIODE. Likharev, K. K. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 20: No. 3, 135-137(Mar 1975).

Translated from Radiotekh. Elektron.; 20: No. 3, 660-661(Mar 1975).

A discussion is given of new properties which arise when three superconducting electrodes take part in the Josephson interaction. The equivalent circuit, the method of fabrication, and the I-V characteristics of the triode are presented. (PMA)

29005 Nb-Nb THIN-FILM JOSEPHSON JUNCTIONS. Hawkins, G.; Clarke, J. (Department of Physics, University of California, and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). J. Appl. Phys. 47: No. 4, 1616-1619 (Apr 1976).

We report a simple technique for the construction of thin-film Josephson tunnel junctions in which both electrodes are of sputtered Nb. A thin (8–20 Å) layer of Cu evaporated over the first oxidized Nb film prevents the formation of supershorts between the Nb films. The junctions are extremely rugged, and do not require protection against condensation of water vapor. A number of junctions have been stored at room temperature for six months and cycled to liquid-helium temperatures 50 times without significant deterioration. Critical currents in the range $1\ \mu A < I_c < 10$ mA may be achieved with an accuracy of ±20%. The dependence of junction characteristics on temperature, oxidation time, and Cu thickness is described. The junctions are particularly suited to the fabrication of practical devices such as SQUID's. (auth)

29006 LOGIC DESIGN OF JOSEPHSON NETWORK. Nakajima, K.; Onodera, Y. (Research Institute of Electrical Communication, Tohoku University, Sendai, Japan); Ogawa, Y. J. Appl. Phys. 47: No. 4, 1620-1627 (Apr 1976).

New logic circuits are designed which employ as information bits the flux-quantum vortices occurring in Josephson junctions of extended dimensions. It is shown that Josephson lines can be interconnected in certain direct ways so that complete logic capability can be achieved with networks of Josephson lines alone. (auth)

29007 INVESTIGATION OF THE TRAINING PROBLEM OF SUPERCONDUCTING MAGNETS. Schmidt, C. (Kernforschungszentrum Karlsruhe, Institut für Experimentelle Kernphysik, 75 Karlsruhe, Postfach 3640, Federal Republic of Germany). Appl. Phys. Lett. 28: No. 8, 463-465 (15 Apr 1976).

The behavior of superconducting NbTi wires under dynamic mechanical stress was investigated. Instabilities on the stress-strain curve (serrated yielding) were found connected with local transition into the normal state. With applied field and transport current, NbTi conductors with and without copper matrix showed a training behavior. This means that the normal transitions occurred at successively higher stress levels. Mechanisms proposed so far, such as serrated yielding of NbTi or deformation of the copper matrix in compound conductors, do not seem to explain the training of superconducting magnets. (auth)

29008 DIRECT OBSERVATION OF THE RIEDEL SINGULARITY IN A SUPERCONDUCTING POINT CONTACT. Vernet, G.; Adde, R. (Institut d'Electronique Fondamentale, Laboratoires Associé au CNRS, Université Paris XI, 91, Orsay, France). Appl. Phys. Lett. 28: No. 9, 559-561 (1 May 1976).

An heterodyne detection of the Josephson current in the gap region is performed using the oscillator-mixer mode of operation in a superconducting point contact. The direct observation of the Riedel peak in a Josephson device is realized. The measured peak height (~3.5) in superconducting point contacts is of the same order of magnitude as for oxide barrier tunnel junctions. Consequently, strong similarities exist in the physical processes which occur in these two types of junctions and pair tunneling is believed to be a dominant mechanism in a point contact with Josephson behavior. (auth)

29009 DIRECT DETECTION OF THE JOSEPHSON RADIATION EMITTED FROM SUPERCONDUCTING THIN-FILM MICROBRIDGES. Pedersen, N.F.; Soerensen, O.H.; Mygind, J. (Physics Laboratory I, The Technical University of Denmark, DK-2800 Lyngby, Denmark); Lindelof, P.E.; Levinsen, M.T.; Clark, T.D. Appl. Phys. Lett. 28: No. 9, 562-564 (1 May 1976).

We report direct measurements of the Josephson radiation emitted in *X* band from a superconducting thin-film microbridge coupled to a resonance cavity. Power is emitted if one of the harmonics of the Josephson frequency is in the bandwidth of the receiver. The maximum power emitted during our experiment was 10^{-13} W. The Josephson radiation could easily be detected at frequencies off resonance. (auth)

29010 MAGNETIC FIELD SHIELDING BY A SUPERCONDUCTING CYLINDRICAL TUBE OF FINITE LENGTH. Thomasson, J.W.; Ginsberg, D.M. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). Rev. Sci. Instrum. 47: No. 3, 387-388 (Mar 1976).

The shielding of the internal volume of a superconducting tube from an external magnetic field aligned parallel to the tube axis is incomplete since the ends of the tube are open. The magnetic field at the center of the tube is reduced from the external field by a factor of $1.13\times10^{-ph/a}$, where $p=5/3$, for a tube length $2h$ which is at least as large as the diameter $2a$. (auth)

29011 GERMANIUM-OVERCOATED NIOBIUM DAYEM BRIDGES. Holdeman, L.B.; Peters, P.N. (Space Sciences Laboratory, George C. Marshall Space Flight Center, Huntsville, Alabama 35812). Appl. Phys. Lett. 28: No. 10, 632-634 (15 May 1976).

Overcoating constriction microbridges with semiconducting germanium provides additional thermal conductivity at liquid-helium temperatures to reduce the effects of self-heating in these Josephson junctions. Microwave-induced steps were observed in the *I-V* characteristics of an overcoated Dayem bridge fabricated in a 15-nm-thick niobium film; at

4.2 K ($T_c - T = 2.6$ K), at least 20 steps could be counted. No steps were observed in the *I-V* characteristics of the bridge prior to overcoating. In addition, the germanium overcoat can protect against electrical disturbances at room temperature. (auth)

29012 DIELECTRICS FOR SUPERCONDUCTING SYSTEMS. Gauster, W. F.; Kernohan, R. H.; Long, H. M.; Schwenterly, S. W. (Oak Ridge National Lab., TN). pp 534-543 of 1973 Annual Conference on Electrical Insulation and Dielectric Phenomena. Washington, DC; National Academy of Science (1974).

From 1973 annual conference on electrical insulation and dielectric phenomena; Varennes, Quebec, Canada (29 Oct 1973).

A program to provide high voltage cryogenic dielectric data is described. Progress is reported on the construction and installation of high voltage apparatus. (Electr. Electron Abstr.)

29013 DESIGN CONCEPT FOR LARGE SUPERCONDUCTING ALTERNATORS. Kirtley, J. L. Jr.; Furuyama, M. (Massachusetts Inst. of Tech., Cambridge). IEEE Trans. Power Appar. Syst.; PAS-94: No. 4, 1264-1269(1975).

From IEEE PES winter meeting; New York, NY, USA (26 Jan 1975).

The necessity for system damping and fault survival have imposed requirements on superconducting alternators not considered in earlier studies. These requirements impinge mostly on the rotor shielding system, and seem to indicate a two-component rotor damper/shield. Projections of machine size and performance indicate that even with the new requirements, superconducting machines retain their projected advantage over conventional machines.

29014 SUPERCONDUCTIVE ENERGY STORAGE INDUCTOR-CONVERTER UNITS FOR POWER SYSTEMS. Peterson, H. A.; Mohan, N.; Boom, R. W. (Univ. of Wisconsin, Madison). IEEE Trans. Power Appar. Syst.; PAS-94: No. 4, 1337-1348(1975).

From IEEE PES winter meeting; New York, NY, (USA) (26 Jan 1975).

Large magnets with superconductive windings could serve to perform a power system function analogous to pumped hydro storage. A conventional Graetz bridge converter, as used in dc transmission, provides an ideal interface between the three-phase power system and the superconductive magnet or inductor. Such Inductor-Converter or I-C units, when properly controlled, provide significant power system benefits. Power reversibility is achievable within a few cycles without switching. Power system electromechanical oscillations can be damped effectively. Computer studies reveal that this damping capability may be useful even with smaller inductor sizes when energy storage in large amounts is not the primary objective. For sizes greater than 1,000 MWh, economic studies show promise. (auth)

29015 VERY SENSITIVE INSTRUMENTS USING rf SQUID. Tichy, R. (CSAV, Rez, Czech.). Cesk, Cas. Fys.; 24: No. 4, 393-394(1974). (In Czech)

The principle, construction and applications of superconducting quantum interference devices (SQUID) are outlined. They are based on a superconducting ring with a Josephson function to which an inductively coupled rf parallel resonant circuit is coupled. The principles of digital and analogue measurements are outlined. The SQUID devices can be used in measurements of magnetic variables, voltage, temperature, as zero detectors in af bridges, measurements of inductances and small resistances, measurements of Earth magnetic flux and measurements of magnetic phenomena in heart and brain. Leading manufacturers of SQUID devices are mentioned. (Electr. Electron Abstr.)

29016 SPECIALLY DESIGNED CRYOSTAT FOR MEASUREMENT OF CRITICAL CURRENT DENSITY FOR STUDY OF LOW TEMPERATURE NEUTRON IRRADIATION EFFECT ON SUPERCONDUCTORS. Tsubakihara, H.; Nishimoto, M.; Okada, T.; Suita, T. (Osaka Univ.). Technol. Rep. Osaka Univ.; 24: No. 1155-1190, 37-41(Mar 1974).

A cryostat for the measurement of the critical current density in short sample superconductors was specially designed. This is particularly suitable for the transfer of the sample from a low temperature neutron irradiation loop to the cryostat without any temperature rise. The ranges of measurement in temperature, applied magnetic field and current carrying capacity in the cryostat are 1.8 ~ 4.2°K, 0 ~ 14.3 kG and 0 ~ 30 A, respectively.

29017 NEW RESULTS REGARDING SUPERCONDUCTING MAGNETS. I. Properties of Superconducting Materials. Novak, D. (MTA Atommag Kutato Intezete, Debrecen, Hungary). Fiz. Sz.; 24: No. 5, 150-156(May 1974). (In Hungarian)

A summary of the basic properties of superconductors includes the Meissner effect, critical temperature, critical current and superconduction in thin films. The above properties are explained according to the BCS theory. Properties of class II superconductors are also discussed.

29018 APPLICATION OF SUPERCONDUCTIVITY TO ROTATING ELECTRICAL MACHINES. Hayden, J. T. Coventry, Eng.; Warwick University (1973). vp.

Thesis.

The possibilities of utilizing superconducting windings in conventional types of rotating machines are examined. It is shown that probably only the dc homopolar machine, the synchronous machine and a toroidal reciprocating generator proposed by Harrowell are suitable for development with superconducting windings. The present state of development of superconducting dc homopolar machines is described, and the economic and market prospects for such machines are assessed. Design procedures for the Harrowell machine are proposed, and some conclusions are drawn regarding its characteristics. The prospects for superconducting synchronous generators are examined for use in large power systems and shown to be promising. The experimental work reported covers the design, construction and testing of a 400 Hz rotating armature synchronous generator, with a rating of 50 kVA initially, but capable of being extended to kVA subsequently.

Heat Transfer and Fluid Flow

Refer also to abstracts 28820, 29415, 32170, 32382, 32384, 32399, 32414, 32415, 32420, 32442, 32449, 32452, 32530, 32539, and 32540.

29019 (CTOM-17938) HEAT TRANSFER TO SPRAY FLOW IN A VERTICAL HEATED CHANNEL. Pang, S. H. (Queen's Univ., Kingston, Ontario (Canada). Dept. of Mechanical Engineering). 1973. 195p. INIS.

Microfiche only.

The heat transfer to a mixture of vapor and droplets of Freon 113 flowing in a vertical heated square channel (.625 in.) was investigated experimentally. The effects of variations in vapor flow rate (200 to 950 lb/hr), liquid injection rate (70 to 350 lb/hr) and wall heat flux ($.58 \times 10^4$ to 1.8×10^4 Btu/hr ft^2) on channel wall temperature distribution were examined. A one-dimensional analysis was presented for the spray flow regime, in which it was assumed that evaporation of droplets occurred under thermodynamic non-equilibrium conditions, i.e. with saturated liquid droplet in a superheated vapor phase. This analysis started at the dryout point which was determined experimentally. The initial droplet size was calculated from the vapor and liquid flow rates at the entrance to the channel. The analytical results agree well with experimental data.

29020 ON ULTRASONIC TESTING OF NUCLEAR REACTOR PRESSURE VESSELS. Kolb, K.; Woelfel, M. Materialpruefung; 17: No. 10, 352-358(Oct 1975). (In German)

9 figs.; 4 refs.

For the detection of "sound-plane" flaws orientated vertical to the surface by the ultrasonic testing of reactor pressure vessels the single probe technique is supplied by the tandem technique. The nature of the internal cladding, choosing the testing frequency, and the horizontal angular deviation of the flaw related to the sound beam plane of the transmission channel have an effect on the certainty of the test results. The consequences of these factors are investigated. Proposals for decreasing the effect of errors and consequently for the improving of the certainty of results are subject of the discussion. (DE)

29021 TRANSPORT COEFFICIENTS HELIUM-NEON, HELIUM-NITROGEN AND HELIUM-CARBON DIOXIDE GAS MIXTURES IN THE TEMPERATURE RANGE OF 0 TO 1,000°C AND PRESSURE RANGE OF 1 TO 100 BAR. Bammert, K. (Technische Univ. Hannover (F. R. Germany)); Klein, R. (Gutehoffnungshuette Sterkrade A. G., Oberhausen-Sterkrade (F. R. Germany)). Atomkernenergie; 26: No. 4, 217-228(1975). (In German)

18 figs.; 2 tabs.; 73 refs.

To be able to define the influence of helium-neon, helium-nitrogen, and helium-carbon dioxide gas mixtures on closed-cycle gas turbine plants—and in particular on the heat exchanging apparatus—investigations were carried out with the aim of determining the transport coefficients of the said mixtures. The temperature dependence of the dynamic viscosity and thermal conductivity of the pure gases at atmospheric pressure were determined, and based on these results and on previous measured values for gas mixtures, the transport coefficients of gas mixtures at atmospheric pressure were determined. The dependence on pressure of the transport coefficients was determined from information on the real gas behavior. As is generally known, both viscosity and thermal conductivity increase with temperature.

29022 NUMERICAL STUDIES ON THE STABILITY OF PLANE LAMINAR FLOWS IN BOUNDARY LAYERS. Kuemmerer, H. Stuttgart; Stuttgart Univ. (1973). 129p. (In German). INIS.

Thesis.

In analogy to the well-known ORR-SOMMERFELD equation derived from the NAVIER-STOKES equation by the small oscillations method, an extended perturbation differential equation is derived in which the influence of the boundary layer thickness on the stability of plane laminar flows in the boundary layers is considered in the framework of the theory of linear stability. (DE)

29023 BUBBLE FORMATION AND HEAT TRANSFER ON BOILING IN FREE AND FORCED CONVECTION. Mayinger, F. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Verfahrenstechnik). Chem.-Ing.-Tech.; 47: No. 18, 737-748(Sep 1975). (In German)

16 figs.; 3 tabs.; 48 refs.

The most important phenomena of heat and mass transfer during evaporation are described and a number of approaches for calculating heat transfer coefficients explained. The article considers boiling, under both free convection and forced flow along heating surfaces, over the whole range expected in a steam generator, from introduction of cool liquid to complete evaporation. (DE)

29024 HEAT PIPE: ITS DEVELOPMENT, AND ITS AEROSPACE APPLICATIONS. Reay, D. A. (Int Res and Dev Co Ltd, Newcastle upon Tyne, Engl). Aeronaut. J.; 78: No. 765, 414-423 (Sep 1974).

A heat pipe is a closed structure containing a working fluid which transfers thermal energy from one part of the structure to another part by means of vaporization of a liquid, transport and condensation of the vapor, and the subsequent return of the condensate from the condenser by capillary action to the evaporator. Applications range from the use of liquid helium heat pipes to aid target cooling in particle accelerators, to potential developments aimed at new measuring techniques for the temperature range 2000-3000^{0}C. Their use in satellites and other spacecraft will eventually cover most of the temperature range. Various heat pipe designs and their functional use in equipment are described. (auth)

29025 ANALYSIS OF BOILING HEAT TRANSFER ON A FIN. Takeyama, T.; Endo, T.; Owada, K. (Univ. of Tohoku, Sendai, Jpn). Heat Transfer-Jpn. Res.; 3: No. 2, 10-22(Apr-Jun 1974).

The boiling curve is approximated as a combination of straight lines on log-log coordinates. Comparing this result with that obtained by the Runge-Kutta method using more accurate heat transfer coefficients, the shape of the mixed boiling curve is similar, but the heat flux is $^1/_3$ to $^1/_{10}$ of the Runge-Kutta method results. Experimental data for a fin covered entirely with film boiling are lower than both results, however, which suggests that the local heat transfer coefficient on a fin depends upon the temperature distribution and other factors. Ten sets of mixed boiling were studied. An equation is proposed and fin effectiveness and burnout are considered. (auth)

29026 CALCULATION METHOD FOR COOLER CONDENSERS WITH CONTINUOUS PHASE FINNED TUBES. Oshima, T.; Iuchi, S. (Himeji Inst of Technol, Jpn). Heat Transfer-Jpn. Res.; 3: No. 3, 1-5(Jul-Sep 1974).

A calculation method for cooler condensers with continuous plate finned tubes is presented. An assumption that a sheet of fin divided at the center of the tube axes is attached to a tube is adopted in the calculation of fin efficiency. The three-point method for cooler condensers is applied to the calculation of heat transfer area. The results calculated by this method are in good agreement with the experimental results. (auth)

29027 ATTEMPTS AT THE THEORETICAL ANALYSIS OF FLOW BOILING CRISES. Mikielewicz, J. Pr. Inst. Masz. Przeplyw.; No. 64, 31-39(1974). (In Polish with English abstract).

An analysis of the conditions for the occurrence of heat exchange crises in boiling flow is presented. The analysis is based on a relation between the boiling flow heat transfer coefficient, the heat transfer coefficient for volume boiling, and the heat transfer coefficient for the two-phase flow convection heat exchange. The conclusion was drawn that the collapse of vapor bubble generation within the flow is responsible for the occurrence of heat exchange crises. Analytical formulas describing the heat exchange during the crises are derived. (auth)

29028 COMPARISON OF DIFFERENT FORMULAS FOR THE DETERMINATION OF THE SLIP COEFFICIENT. Bartolomei, G. G.; El'-Garkhi, M. A. (Moscow Power Eng. Inst., USSR). Teploenergetika (Moscow); No. 9, 71-73(Sep 1974). (In Russian).

In calculating true steam content in an equilibrium flow, the ratio between the true velocities of steam and water (slip coefficient) is important. Three formulas for calculating the true steam content on the basis of the velocity ratio are considered and compared with experimental data. A formula is singled out which permits slip coefficient for pipes of different diameters to be calculated with higher accuracy than the other two formulas when the velocity ratio is greater than 3. (auth)

29029 INVESTIGATION OF HEAT AND MASS TRANSFER DURING THE FLOW OF DISPERSED GAS/LIQUID MIXTURE IN A CURVILINEAR SEPARATING DUCT. Ryzhkov, S. V.; Ershov, V. V.; Albantov, A. K. (Nikolaev Shipbuild Inst., USSR). Teploenergetika (Moscow); No. 9, 79-82(Sep 1974). (In Russian).

An investigation of the capture coefficient, the magnitude of the wetted surface, and heat transfer in a one-phase air flow is carried out. An approximate analogy between heat and mass transfer processes is used. Formulas are obtained that are useful for the calculation of heat transfer during the flow of dispersed air/water mixture in a curvilinear duct. Experimental results and theoretical calculations show satisfactory agreement. (auth)

29030 DETERMINATION OF THE HEAT TRANSFER ON MOUNTING PLATES FOR BUNDLES OF TUBES. Dagsoez, A. K. (Istanbul Technical Univ. (Turkey). Lehrstuhl fuer Kernenergie und Waermeuebertragung). Wasser, Luft Betr.; 19: No. 7, 395-397(Jul 1975). (In German)

9 figs.; 5 refs.

Helix boilers consist mainly of helical tubes connected by mounting plates. The plates carry cylindrical bundles of tubes which are sealed individually. In order to analyze the stress in the carrier plates, experiments were carried out to determine the heat transfer coefficient between plate and medium. Proposals for estimating the heat transfer figure between gas and plate are given. (DE)

29031 INVESTIGATING BURNOUT WITH FLOW OF A STEAM-WATER MIXTURE IN A ROUND TUBE. Levitan, L. L.; Lantsman, F. P. (All-Union Heat Engineering Inst., Moscow). Therm. Eng. (USSR) (Engl. Transl.); 22: No. 1, 102-105(Jan 1975).

Translated from Teploenergetika; 22: No. 1, 80-83(Jan 1975).

Two different types of burnout can occur with two-phase flow in a tube. The first arises with relatively low steam contents (bubble and annular flow regimes) and high heat fluxes of the heating surface. The second arises with higher steam contents under conditions of dispersed annular steam-water flow. World literature of experimental data on burnout was analyzed, and experiments were performed for both types of burnout to establish reliable values of critical heat fluxes for steam-water flow conditions. For the first type an empirical equation is derived for the critical heat flux as a function of pressure, mass velocity, and relative enthalpy at the point of burnout. For the second type of burnout an empirical expression is established which relates the limiting steam content to the pressure, mass flow, and tube diameter. (LCL)

29032 CALCULATING THE CRITICAL FLUX DURING BOILING OF A MIXTURE IN A LARGE VOLUME. Gaidarov, Sh. A. Zh. Prikl. Mekh. Tekh. Fiz.; No. 4, 146-148(1975). (In Russian)

On the basis of a hydrodynamic theory of a boiling crisis (burnout) of liquids, an equation was derived, by means of which it is possible to calculate the magnitude of the critical (burnout) heat flux during boiling of binary mixtures in a large volume under conditions of natural convection. The equation satisfactorily describes the experimental data on the burnout heat flux during boiling of ethyl alcohol-water and methyl alcohol-water. (SJR)

29033 HEAT AND MASS TRANSFER FROM FREELY FALLING DROPS. Yao, S. C. (Argonne National Lab., IL); Schrock, V. E. J. Heat Transfer; 98: No. 1, 120-126(Feb 1976).

When a drop breaks free from a liquid film or feeding orifice and falls through an atmosphere of lower temperature it experiences a transient heat and mass transfer process involving acceleration, the development of hydrodynamic, thermal, and concentration boundary layers in the gas, oscillation of the drop shape, and the development of internal circulation within the drop. This problem, which is of importance in evaporative cooling systems, has been studied experimentally for water drops 3-6 mm in diameter falling through air. Study of a simplified set of governing equations indicates that similitude does not exist in this problem. However, it has been found that for this size range an approximate procedure based on the assumption of negligible internal thermal resistance and an empirical transient correction factor applied to the Ranz-Marshall correlation could describe the data very well.

29034 ELECTROLUMINESCENT STORAGE SCREENS IN X-RAY FLAW DETECTION. Amfiteatrov, V. V.; Kudryavtseva, M. V.; Lipin, A. L. (Inst. of Applied Chemistry, Leningrad). Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 3, 394-395(1975).

Translated from Defektoskopiya; 11: No. 3, 142-144(1975).

An electroluminescent storage screen consisting of a special zinc-cadmium sulfide preparation activated with manganese is described. The screen is suitable for recording images in x-ray flaw detection. The screen is less expensive than x-ray films. (TFD)

29035 HEAT PIPES. Voronin, V. G.; Drozdov, O. A.; Kotova, T. P.; Mauerman, M. M.; Revyakin, A. V.; Tarasov, V. S. USSR Patent 422,925. 6 Sep 1974. Filed date 21 Apr 1972. vp. (In Russian).

The design of a heat pipe containing a case with a capillary-porous material on the inner surface, having vaporizing, transporting, and cooling condensation zones, is described. For the purpose of increasing the heat exchange and improving the compactness inside the case, an additional cooling element with a capillary-porous material on its outer surface is introduced into its condensation zone. The distinguishing feature of the pipe is that the cooling element is made in the form of a tubular coil connected to the distributing and accumulating collectors. The collectors are arranged on opposite sides of the case at the boundary of the condensation and transport zones. (auth)

29036 HEAT TRANSFER IN TURBULENT SEPARATED FLOW. Smyth, R. (Sheffield Univ. (UK)). J. Nucl. Sci. Technol. (Tokyo); 11: No. 12, 545-553(Dec 1974).

An investigation was carried out with the object of determining the physical effects of separation and the associated reattachment and redevelopment, upon the heat transfer characteristics of turbulent flow in pipes and to compare the results of these flow conditions with the fully developed one-dimensional condition and with a recently developed numerical technique for the solution of recirculating flows. Separation of the flow was induced in a 4 ft length of 2 in. internal diameter nicrome tube at wall thickness 0.001 in. by means of a sudden enlargement of diameter at the entry of the tube. The tube was electrically heated by the passage of a current along its length. The first 25 in. of the tube was metered by thermocouples which gave the wall temperatures and from these the local heat transfer rates and Reynolds numbers up to 5×10^4 using air as the working fluid. (auth)

Materials Testing

Refer also to abstracts 29498, 31015, 32497, 32507, 32535, and 32537.

29037 (AGARD-AG-201(Vol. 2)) NON-DESTRUCTIVE INSPECTION PRACTICES. Bolis, E. (ed.). (Advisory Group for Aerospace Research and Development, 92 – Neuilly-sur-Seine (France)). Oct 1975. 190p. NTIS.

Nondestructive methods for inspection and testing of aircraft components are presented in chapters entitled: The Non-Destructive Measurement of Residual Stress; NDI of Welding; NDI of Bonded Structures; NDI of Composite Materials; and Detection and Measurement of Corrosion by NDI. The methods include ultrasonic eddy current, radiography, holography, thermal, sonics, electrical, electromagnetic, and visual. Appendices include Subject Index; Cross Reference Table Showing which NDI methods may be used for investigating various type of defects; Non-Destructive Inspection Procedures, USAF; and Non-Destructive Test Manual, Boeing Document D67170. (TFD)

29038 (CEA-CONF-3142) EDDY CURRENT TUBE TESTING UNIT. Dufayet, J. P.; Duret, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). 1975. 19p. (In French). INIS.

From conference on the electromagnetic methods of quality control for materials and products; Riga, USSR (30 Sep 1975).

The unit described can check a wide variety of tubes in quick succession and its modular design gives it a high degree of versatility. Suitably defined working conditions and specific fittings enable most of the faults encountered in the manufacture of a tube to be detected. By appropriate means of selection based on signal amplitude, phase and frequency analyses, it is possible to adapt selection criteria to the seriousness of the different categories of defect.

29039 (EUR-5108) ULTRASONIC SIGNATURE. Borloo, E.; Crutzen, S. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Dec 1974. 54p. INIS.

The unique and tamperproof identification technique developed at Ispra is based on ultrasonic non-destructive-techniques. Reading fingerprints with ultrasonic requires high reproducibility of standard apparatus and transducers. The present report gives an exhaustive description of the ultrasonic technique developed for identification purposes. Different applications of the method are described. (auth)

29040 (ZVU-P-1532) THE USE OF LINEAR ACCELERATORS FOR GAMMA RADIOGRAPHY. Poulard, S. (Zavody Vitezneho Unora, Hradec Kralove (Czechoslovakia)). [nd]. 13p. (In Czech). INIS.

7 figs; translated from Nondestr. Test. (Sep 1972). v. 5(5) p. 303-306. Available from Trust Podniku Chepos, Hradec Kralove (Czechoslovakia). Zavody Vitezneho Unora.

The use of linear accelerators for radiography for nondestructive testing is still in its infancy. The operation of linear accelerators is described from the point of view of gamma radiography. The working parameters and limits are discussed. Installations in operation in France are described and it is proposed that hiring the facilities out by the beam-hour would best serve the development of this method of gamma radiography.

29041 CHLORIDE ABSORPTION BY BITUMINOUS ANTICORROSIVE PROTECTIVE COATINGS DEMONSTRATED BY USING TRACER TECHNIQUES. Schober, E. (Zentralinst Einheitsyst Bau, E Ger). Plaste Kaut.; 21: No. 9, 701-702(Sep 1974). (In German).

A brief report is given of a tracer technique to replace the conventional corrosion test using aqueous solution of sodium chloride. In the new method, isotope ^{36}Cl was used as tracer. This new test technique was shown to be reliable enough to be applied to assessment of bituminous coating of steel rods used in silicate concrete. (auth)

29042 ENGINE TESTING USING ADVANCED TECHNIQUES. Stewart, P. A. E. (Rolls-Royce, Ltd., Bristol, Eng.). Aeronaut. J.; 79: 331-343(Aug 1975).

From joint meeting of Institute of Electronic and Radio Engineers, Institution of Electrical Engineers, and Royal Aeronautical Society; Bristol, England (19 Feb 1975).

The application of high energy radiography to gas turbine development and testing is discussed. The technology of high energy radiographic systems and the techniques of fluoroscopy and x-ray photogrammetry are described. The principles of radiography are summarized, together with various sources of high-energy radiation and radiation safety procedures.

29043 QUALITATIVE DISCUSSION OF QUANTITATIVE RADIOGRAPHY. Berger, H.; Motz, J. W. (National Bureau of Standards, Washington, DC). pp 37-53 of Prevention of Structural Failure: The Role of Quantitative Nondestructive Evaluation. Metals Park, OH; American Society for Metals (1975).

From proceedings of the second materials/design forum; Port St. Lucie, Florida (USA) (9 Apr 1974).

Since radiography yields an image that can be easily related to the tested object, it is superior to many nondestructive testing techniques in revealing the size, shape, and location of certain types of discontinuities. The discussion is limited to a description of the radiographic process, examination of some of the quantitative aspects of radiography, and an outline of some of the new ideas emerging in radiography. The advantages of monoenergetic x-ray radiography and neutron radiography are noted.

29044 ULTRASONIC INSPECTION RECESS IN HEAT EXCHANGER AND NUCLEAR STEAM GENERATOR TUBESHEETS. Parkinson, J. K.; Ruhe, A. US Patent 3,929,005. 30 Dec 1975. Filed Date 1 Aug 1974. 6p.

A vessel with a butted weld seam is provided with an access slot in its surface at a selected distance from the weld seam. An ultrasonic probe engages with a wall of the slot which is aligned with the weld and signals generated by the probe cross the axis of the weld frontally without substantial reflection from adjacent vessel surfaces.

29045 APPARATUS FOR CARRYING OUT ULTRASONIC INSPECTION OF PRESSURE VESSELS. Dent, K. H.; Challender, R. S. (to United Kingdom Atomic Energy Authority). US Patent 3,929,007. 30 Dec 1975. Filed Date 13 Dec 1973. 4p.

A carriage-supported manipulator for taking an ultrasonic scanner mechanism into a coolant nozzle of a nuclear reactor pressure vessel is described. The manupulator is rotatable about the axis of the nozzle and is radially expansible to urge the scanner mechanism into a scanning position within the nozzle.

29046 DEVICES FOR RADIATION DEFECTOSCOPY. Volkov, A. V.; Semenov, A. P.; Kuznetsov, A. G.; Kotov, A. G. (Scientific-Research and Design Inst. of Assembly Tech., Moscow). Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 3, 270-273(1975).

Translated from Defektoskopiya; 11: No. 3, 18-22(1975).

Various ways and means are employed in the everyday practice of industrial defectoscopy to improve x-raying techniques and ensure the best operating and monitoring conditions. This paper describes three devices for use in radiation defectoscopy to

improve x-raying conditions and increase the efficiency of x-ray monitoring: an x-ray shutter; an x-ray centering device; and a device for the delivery of the cassette carrying the x-ray film.

29047 DESIGN OF A GAMMA-RAY FLAW DETECTOR WITH ANALOG DATA PROCESSING. Silyuk, V. F. (Nondestructive Testing Physics Section, Minsk). Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 3, 274-278(1975).

Translated from Defektoskopiya; 11: No. 3, 22-26(1975).

It is sometimes necessary to revise the method of calculating the details of a flaw detector on the basis of equipment error independent of the mean number of gamma rays recorded. The limits to the use of standard methods and the choice of some instrument parameters are discussed.

29048 RADIOGRAPHICAL INVESTIGATION OF BUILDING STRUCTURES. Runkiewicz, L. (Instytut Techniki Budowlanej, Warsaw (Poland)). Inz. Budownictwo; 30: 155-158(1973). (In Polish)

On the basis of conducted investigations the sensitivity of radiographical method in accordance to concrete is defined, the exactness of reinforcing steel determination in RC structures is stated and the technical conditions of radiographical investigations of structures are determined. Results of investigations of selected engineering objects are presented.

29049 DEVELOPMENTS IN GAMMA RAY RADIOGRAPHY 1928 TO 1941. II. A History of Nondestructive Testing. Briggs, C. W. (Steel Founders Society of America, Cleveland). Mater. Eval.; 34: No. 3, vp(Mar 1976).

From 1st meeting of the American Industrial Radium and X-Ray Society, Inc.; Cambridge, MA, USA (17 Oct 1941). 1941 Mehl lecture.

The lecture traces gamma radiography from its inception by Robert Mehl in 1928 to 1941. The lecture was presented at the first and organizational meeting of the American Industrial Radium and X-Ray Society, Inc., at Massachusetts Institute of Technology on Oct. 17, 1942. (TFD)

29050 RELATION BETWEEN THE STRESS MEASURED BY X-RAY AND THE STRESS INDICATED FROM BRITTLE LACQUER COATING. Arima, J.; Iwai, Y. (Nara Technical Coll., Yamato-Koriyama (Japan)). Zairyo; 23: No. 255, 1034-1038 (Dec 1974). (In Japanese).

The stress measurement by X-rays is based on the variation of lattice spacings of metallic crystals due to stress. It has been noted as a unique method of measuring nondestructively the local stress, especially residual stress. Recently, this X-rays stress measurement has been applied in a very wide field of engineering studies in consequence of development of X-ray equipments as well as improvement in measuring devices. On the other hand, the stress measurement with a brittle lacquer coating is based on the crack development perpendicular to the tensile strain when the loading exceeds a certain value. In this method, the direction of principal stress and the position of stress concentration can be determined directly from the crack patterns on the specimen surface. In comparison with other stress measuring methods, however, the lacquer coating technique has not been widely employed in engineering because of its lower strain sensitivity and the susceptibility to the influence of lacquer ingredients, drying techniques, or conditions of temperature and humidity. In this paper, the authors report the practical usefulness of infrared rays baking device for brittle lacquer of baking type. Moreover, the stress values on plain carbon steel plates determined by the lacquer coating were compared with those by the X-ray method in their elastic range during bending tests. The results obtained are as follows: (1) The measured temperature of a specimen corresponded well with the preset temperature of the baking device, showing the practical usefulness of the device. (2) The stresses obtained by using the lacquer coating and the X-ray techniques at any stage of bending tests in the elastic region agreed well with each other in the range from 4 kg/mm^2 to 20 kg/mm^2. It seems easy to make a reliable stress measurement by X-ray even on the complex machine parts or structures, if the direction of principal stress and the pattern of stress distribution are preliminarily analysed by the brittle lacquer coating method. (auth)

29051 HIGH-RESOLUTION FAST-NEUTRON AND GAMMA DIGITAL RADIOGRAPHY. de Volpi, A. (Argonne National Lab., IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 350-353(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The fast neutron hodoscope at TREAT can be modified for high resolution radiography. Time-resolved radiography normally performed by the hodoscope with coarse spatial resolution may be traded for good space definition at the expense of time resolution, allowing the hodoscope to become a dual purpose instrument. The modifications require remote motorized scanning of the collimator and simultaneous 334-channel data collection over extended intervals of time. By doing so, it becomes possible to generate digital radiographs without the necessity for mechanical disturbance of the object being viewed. Furthermore, separate and distinct images of fuel and steel may be produced. (auth)

29052 APPLICATION OF 5 MeV LINEAR ELECTRON ACCELERATOR FOR ACTIVATION ANALYSIS. Abbosov, O.; Abrams, I. A.; Kodiri, S.; Pelekis, L. L.; Starchik, L. P. pp 97-99 of Activation Analysis in National Economy. Tashkent; Fan (1974). (In Russian)

A technique is described for the radioactivation determination of Au, Pt, Pd, and Ir in concentrated samples obtained from an ore sample weight of 5 to 10 grams by double precipitation by thiourea from sulfuric acid solution. After the precipitate dissolves in aqua regia, the salts of the noble metals are converted to chlorides. Aliquot portions of the solution are placed on filter paper which is irradiated along with standards in a reactor at a flux of 1.2×10^{13} neutrons/cm^2 sec over a period of 20 hours. The irradiated samples are held for a period of 7 days. In determining Pd, the irradiation is carried out in Cd foil in order to decrease the ^{24}Na activity. Measurement of the induced γ spectrometer with a Ge(Li)-detector and a 4000 channel analyzer, and on a γ spectrometer with a NaI(Tl) crystal of the well type. The sensitivity of determining Au, Ir, Pt, and Pd was 1×10^{-8}, 1×10^{-9}, 5×10^{-7}, and 1×10^{-7} grams respectively.

Nuclear Explosions

Refer also to abstracts 29097, 29140, 29253, and 29419.

29053 (AD/A-005775) PROGRESS REPORT NORSAR PHASE 3. Quarterly No. 4. Berteussen, K. A. (Norges Teknisk-Naturvitenskapelige Forskningsraad, Kjeller, NORSAR). 31 Jan 1975. Contract F08606-74-C-0049. 23p, NTIS $3.25.

See also quarterly progress rept. No. 3, AD/A;002252.

The report covers operation and research activities at the Norwegian Seismic Array (NORSAR) for the period 1 October-31 December 1974. A small increase in the number of instruments with characteristics outside tolerance limits has been observed, also some of the computer units have had several short stops due to faulty components. Except for that the performance of the field instrumentation and the computer installations has been satisfactory. A floating threshold procedure has been implemented in the Detection Processor. In the Event Processor some additional statistical tests have been included as a result of a study of signal-noise classification problems. A study of precursors to PP has been finished.

29054 (AD/A-006430) EQUILIBRIUM SHAPE AND POSITION OF A NEUTRAL HEAVE FIREBALL. Topical Report. Simons, G. A. (Physical Dynamics, Inc., Berkeley, Calif. (USA)). 24 Jan 1975. Contract DNA001-73-C-0101. 17p. (PD-74-070). NTIS $3.25.

The difference between heave and fireball motions is determined on the basis of whether or not heated fluid elements retain their relative vertical position as they rise. In the heave regime, fluid elements do not circulate in the conventional sense; these circumstances allow a great simplification, enabling one to determine the equilibrium position of fluid elements solely in terms of the initial energy distribution in an otherwise isothermal atmosphere. Results indicate that, at late time, lateral spreading dominates the vertical rise.

29055 (INIS-mf-1862) NORSAR (NORWEGIAN SEISMIC ARRAY). Report for the Period 1.7. 1972–30.6. 1974. Bungum, H. (Norges Teknisk-Naturvitenskapelige Forskningsraad, Kjeller, NORSAR). Dec 1974. 38p. (In Norwegian). INIS.

The purpose of the Norwegian Seismic Array (NORSAR) is to carry out research on distinguishing underground nuclear explosions from earthquakes by seismic methods. NORSAR is largely financed by the Advanced Research Agency, USA (ARPA), and is connected to the ARPANET computer network in the US by satellite. The general background of NORSAR work is presented, and a description is given of the array of seismic stations, their seismometers, and the data center. A brief description of ARPANET and a general description of the research program at NORSAR and of the international cooperation in the field are given. The Nuclear Test Ban Treaty of 1974 is briefly presented and discussed, and a publications list is given.

29056 (INIS-mf-1863, pp 184-187) NORSAR – NORWEGIAN SEISMIC ARRAY. 1975. (In Norwegian).

In annual report 1974. (Norges Teknisk-Naturvitenskapelige Forskningsraad, Kjeller. NORSAR).

Improvements in the ability of the NORSAR systems to detect and locate seismic events continued in 1974, and analyses indicate that optimal operation is closely approached. The system is most

sensitive for events at 30°-90° (3000-9000 km) from the array, but events outside this range can also be registered with good quality. All data is stored on magnetic tape for 1 year, after which only special periods with interesting data are permanently stored. The NORSAR bulletin is sent daily to all Scandinavian seismological institutes by telex and to 66 institutes in 17 countries by post. Data is also exchanged with the U. S. by satellite. The emphasis in the research program is now on distinguishing between earthquakes and underground nuclear explosions, research requiring a broad spectrum of tasks in geophysics, statistics, signal theory, and data processing. The results of the NORSAR research are documented mainly in international seismological and geophysical journals.

29057 (INIS-mf-1932) TREND REPORT ON NUCLEAR EXPLOSION: PEACEFUL APPLICATIONS IN PETROLEUM INDUSTRY. Gupta, D. K. (Institute of Petroleum Exploration, Dehra Dun (India)). 1974. 76p. INIS.

This state-of-art report describes the processes in underground nuclear explosions which can be usefully applied to the petroleum industry. Nuclear explosions can be economically applied, (a) for well stimulation for oil and gas production from the thick and low-permeable formations which are difficult or uneconomic with the conventional techniques, (b) for exploiting oil shales and (c) for underground storage of oil and gas. The types of reservoirs which can be stimulated by nuclear explosions and the economics of such operations and nuclear devices are also described. An extensive bibliography citing 147 references is appended.

29058 (PB-239294) READY I SYSTEM FOR THE UNIVAC 1108 WEAPONS PREPARATION PROGRAM. Revision No. 1, Final Report. (General Services Administration, McLean, Va. (USA). Mathematics and Computation Lab.). Nov 1974. 26p. (GSA/OP/MCL-TM-234(Rev.1)). NTIS $3.75.

Supersedes report No. PB-224854.

This technical Manual contains detailed instructions for users of the Weapons Preparation Program. It contains information concerning the several options of the program, input-output formats, and operating procedures. (GRA)

29059 (SAND-75-0402) RESPONSE OF PHOTOCHROMIC MATERIALS TO INTENSE LIGHT FLASHES. Harrah, L. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1976. Contract AT(20-1)-789. 29p. Dep. NTIS $4.00.

Calculations were performed to estimate the ability of triplet photochromic materials to limit the visible fluence from nuclear flashes. The parameters chosen for the triplet state absorption in the visible were based on an oscillator strength of unity and an absorption spectrum covering from 405 to 650 nm. A triplet state population quantum efficiency of 0.3 was used as representative of the reported values for molecules absorbing in this region. Analytical expressions are derived for both short pulses and for the steady state case. For the nuclear flashes where the time of the pulse is comparable to the triplet decay time, a computer solution is used to calculate the achieved optical density and transmitted fluence as a function of time. From these calculations, it is concluded that photochromics can provide thermal protection but probably cannot prevent temporary flash blindness. (auth)

29060 CONTINUITY AND CHANGE IN FRENCH NUCLEAR POLICY. Saxena, Jyotsna (Institute for Defence Studies and Analyses, New Delhi (India)). Inst. Def. Stud. Anal., J.; 6: No. 3, 396,415(Jan 1974).

46 refs.

An attempt has been made to examine the new orientations of the French nuclear policy under President Pompidou, in the light of its genesis and evolution under the Fourth Republic and President De Gaulle. It has been said that the French option for an independent nuclear force was not the outcome of General De Gaulle's power politics. The decision to go nuclear was taken paradoxically under the Fourth Republic whose major choice in military strategy was the subordination of the national defence system to a global Atlantic defence system, defined by the United States. (INIS)

29061 CALCULUS OF NUCLEAR COUNTERFORCE. Tsipis, K. (Stockholm International Peace Research Inst.). Technol. Rev.; 77: No. 1, 34-37(1974).

An assessment of the nuclear counterattack capability of the USA and USSR against nuclear attack is presented. (TFD)

29062 TELESEISMIC SOURCE PARAMETERS OF THE LONGSHOT, MILROW, AND CANNIKIN NUCLEAR EXPLOSIONS. King, C. Y.; Abo-Zena, A. M.; Murdock, N. N. J. Geophys. Res.; 79: No. 5, 712-718(10 Feb 1974).

Teleseismic P-wave spectral ratios in the frequency band 0.2 to 3.5 Hz between the LONGSHOT, MILROW, and CANNIKIN nuclear explosions detonated under Amchitka Island can be explained well on the assumption that each source consists effectively of three P phases (direct, pP, and slapdown) with the following parametric values: the source radii are 0.4, 0.6, and 0.9 km for LONGSHOT, MILROW, and CANNIKIN, respectively; the relative source pressure steps are 1, 2.3, and 3.7; the pP-P time intervals are 0.49, 0.81, and 1.12 sec; and the slapdown-P time intervals are 0.87, 1.35, and 1.85 sec. The amplitudes of the pP and the slapdown phases are estimated to be 0.3 to 0.5 times the corresponding P amplitudes. The source radius, source pressure, pP-P time interval, and slapdown-P time interval all increase linearly with the depth of burial. The apparent average overburden P-wave velocities computed from the known depths and the estimated pP-P delays are 2.9, 3.1, and 3.3 km/sec, respectively. These values are approximately 15 percent lower than the velocities obtained from on-site measurements, indicating a velocity reduction for the surface-reflected P-waves in the inelastic source region. The quantity of source pressure times the cube of the source radius apparently increases linearly with the yield.

29063 NUCLEAR ENERGY AND NUCLEAR WEAPONS: ARE THEY INEVITABLY LINKED. York, H. F. (Univ. of California, San Diego, La Jolla). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 20-24(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

For forty years politically active nuclear scientists have been trying to invent and to promote policies and schemes which would on the one hand make the benefits of nuclear energy available to all mankind, and on the other hand inhibit or prevent the manufacture and use of nuclear weapons. So far, the record of these attempts is poor; it now threatens to get worse fast.

Protective Structures and Equipment

29064 (N-75-31721) LEAD BELT RADIATION SHIELD. Final Report, September–December 1974. Burgio, J. J. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Mar 1975. 20p. NTIS.

Results are given of the effectiveness of a lead shielding belt in reducing the gamma dose to the center of a cylindrical tissue-equivalent phantom exposed to isotropic gamma radiation. Three different shield designs were used. The first was a lead belt 20-cm high (wide), of a thickness varying from 0.0 cm (no belt) to 5.08 cm. The second design belt was 30-cm high (wide), of thickness varying from 0.0 cm (no belt) to 5.08 cm. For the third case, the 20-cm high (wide) lead belt of a thickness varying from 0.0 cm (no belt) to 5.08 cm was used but with a lead seat and back. The results demonstrate the feasibility of using a lead belt to reduce the gamma tissue dose to a tissue-equivalent phantom from an isotropic gamma source. (GRA)

29065 (PB-238731) RISK II: NREC VULNERABILITY ANALYSIS COMPUTATION SYSTEM. Technical Report (Final). Laure, L. G. (National Resource Evaluation Center, Washington, D. C. (USA). Mathematics and Computation Lab.). Jun 1965. 308p. (NREC-TR-11). NTIS $9.25.

The RISK II System is a rapid process to estimate vulnerability probabilities resulting from a thermonuclear attack. The programs are now available for the Remington Rand Univac Scientific 1103AS and the Control Data 3600 Computers. Various formats including graphs and maps show the analysis in terms of probabilities of degree of effect, casualties, availability or damage to specific resource locations or aggregations of resources.

29066 OPERATING EXPERIENCE OF THE ALPHA–GAMMA FACILITY (AGF). Uematsu, K.; Ishida, Y.; Kobayashi, S.; Komatsu, J. (Power Reactor and Nuclear Fuel Development Corp., Akasaka, Japan). Conf. Remote Syst. Technol., Proc.; 22: 3-10 (1974).

From 22nd conference on remote systems technology; Washington, DC, USA (Oct 1974).

The Alpha-Gamma Facility at the PNC O-arai Engineering Center has been operating successfully since October 1971 without experiencing major difficulties. The function of this facility is the physical, metallurgical, and chemical examination of irradiated plutonium-bearing fuels. Two lines of main concrete cells are provided: one has a shielding capacity of 10,000 Ci for irradiated fuels and the other a shielding capacity of 2000 Ci. The main types of examination are nondestructive tests, metallography, physical measurements, and chemical analysis. (auth)

29067 PELINDABA SEES SAFELY. O'Neill, J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Saf. Manage.; 1: No. 3, 27, 29, 32(1975).

One of the largest expenditures of the South African Atomic Energy Board for protective equipment is for providing eye protec-

tion. The eye protection system is described, and details on certain problems and the way in which they were solved are given.

29068 DESCRIPTION D'UN DISPOSITIF DE PROTECTION ET DEFINITION D'UNE PROCEDURE DE REGLAGE POUR LES CHAMBRES PLANES (MONTAGE DE LAUE EN RETOUR). (Description of a Protective Shielding and Definition of a Procedure For Alignment in Atomic Plane Chambers (von Laue's Apparatus)). Vialettes, H.; Petit, G.; Ricaud-Dussarget, P. Saclay, France; Centre d'Etude Nucleaires (1974). 8p.

Experimenters operating the atomic plane chambers of X-ray diffraction units for crystallography are exposed to serious radiation hazards, during normal operation as well as during alignment procedures. This article describes 3 shielding systems, one of which (recently developed) consists of a telescopic perspex hood completely enclosing the part of the experimental set-up where the unprotected X-ray beam penetrates the surrounding free air. The alignment procedure which has to be adopted when the shield is in position also contributes to reducing the exposure hazard. (CIS Abstr. Vol.2)

Safety Engineering

Refer also to abstracts 32410.

29069 BILDZEICHEN. Strahlung, Allgemein. Entwurf. (Graphical Symbol. Radiation, General. Draft). Berlin, F. R. Germany; Beuth (Jun 1975). 1p. (In German). (DIN-30600 Bl.692)).

1 fig.

The present draft standard describes a graphical symbol which is to be generally used in technical drawing as well as on equipment of all kinds to characterize a radiation. (DE)

29070 ARE NUCLEAR SHIPMENTS REALLY SAFE. Brobst, W. A. (Atomic Energy Commission, Washington, DC). Environ. Lett.; 9: No. 4, 355-378(1975).

The transportation of nuclear materials is on the increase. Although nuclear shipments are only a very small fraction of the Nation's hazardous materials shipments, they attract a great deal of public attention. Shipments of spent nuclear fuel and nuclear wastes are a particular concern. One of the many fears about nuclear energy is the possibility that a nuclear shipment might somehow go awry and cause a serious public hazard. Primarily, the worry is that a shipment of spent reactor fuel or highly radioactive waste could be involved in a serious rail or highway accident and dump its contents all over the countryside. Questions on the possibility of accidents, safety of shipments, number, appearance and testing of packages are answered in the paper. Since public risk is the product of the consequences of an accident and its probability, both aspects are presented so that each person can make up his own mind whether the risk from nuclear shipments is acceptable. (auth)

29071 CARBON MICROSPHERES AS EXTINGUISHING AGENTS FOR FISSIONABLE MATERIAL FIRES. Schmitt, C. R. (Union Carbide Corp., Oak Ridge, TN). Fire Technol.; 11: No. 2, 95-98 (May 1975).

Controlled fire tests were made with 50-g quantities of pyrophoric uranium metal powder to assess the relative degree of airborne contamination associated with the burning and extinguishing of this material using standard high-volume air monitoring equipment. By applying carbon microspheres for extinguishment, the airborne contamination was reduced considerably.

Vacuum Engineering

Refer also to abstracts 32339.

29072 ULTRAHIGH VACUUM APPLIED TO PHYSICS. Redhead, P.A. (Division of Physics, National Research Council of Canada, Ottawa, Canada K1A 0R6). J. Vac. Sci. Technol. 13: No. 1, 5-10 (Jan 1976).

Some of the history of the development of UHV technology, and its effects on surface physics and low-energy collision studies, is presented. The author's role in these developments is suitably over-emphasized. (auth)

29073 PHOTOELECTRICALLY AUTOMATED, BAKEABLE, HIGH-LOAD ULTRAMICROBALANCE. Czanderna, A.W. (Department of Physics and Institute of Colloid and Surface Science, Clarkson College of Technology, Potsdam, New York 13676); Kollen, W.; Biegen, J.R.; Rodder, J. J. Vac. Sci. Technol. 13: No. 1, 556-559 (Jan 1976).

An all quartz pivotal-beam ultramicrobalance has been modified for operation as a null instrument using a dual-path photoelectric detector. The beam and newly designed stainless steel beam support have been adapted to a stainless steel enclosure for studies in uhv. A thin quartz disk, with a 600-Å thick Au film for partially blocking the light path, is fused to each end of the beam. An electronic circuit minimizes the signal from the detector when the balance moves from the null by providing a current output to a magnetic compensation coil. The capacity (up to 20 g), the stability of the null reading (over six months), and the unusually high load to precision ratio ($1–2\times10^8$) of the balance have been maintained with the modification. Sensibilities of 0.03–0.1 μg with 4–10-g loads have been obtained with the balance, which is now completely adapted for UHV operation. (auth)

29074 SUPER-HIGH-VACUUM UNIT. Zatselyapin, A. M.; Stanishevskii, E. Ya. (Crystallography Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1193-1194(1975).

Translated from Prib. Tekh. Eksp.: 18: No. 4, 150-151(1975).

An all-metal unit for investigating crystallization and vaporization of weakly volatile substances is described. The ultimate residual pressure of $\sim5.10^{-9}$ torr is provided by the operation of two magnetic-discharge pumps. A set of four zeolite pumps is used for preliminary evacuation of the vacuum system to $\sim10^{-5}$ torr.

ENVIRONMENTAL AND EARTH SCIENCES

29075 (INIS-mf) PREVENTION OF RADIOACTIVE POLLUTION AND MODIFICATIONS TO THE LAW OF THE SEA. Queneudec, J. P. (Montpellier-1 Univ., 34 (France)). 1975. 7p. (In French). INIS.

From colloquium on nuclear law and law of the sea; Paris, France (12 Jun 1975).

Colloquium organized by the Centre d'Etudes et de Recherches de Droit International and the Centre d'Etudes du Droit de l'Energie Atomique.

Prevention of radioactive marine pollution and modifications to the law of the sea are discussed on the basis of the work elaborated by the Third United Nations Conference on the Law of the Sea. The purpose of the planned measures is to grant States the competence and powers required to protect the marine environment, given abusive practices. It is also emphasized that, according to proposals made at the Caracas meeting in 1974 and at the Geneva meeting in 1975, modernisation of the law of the sea will concern particularly a strenthening of the rights and powers of coastal States and the sanction of measures taken unilaterally by some States to preserve their territorial seas from pollution. Mention is also made of proposals following the recommendation of the United Nations Conference (Stockholm 1972) on control of radioactive pollution from nuclear surface ships and submarines. (FR)

29076 (LA-6084-MS) RESPIRATOR PROTECTION FACTORS. Hyatt, E. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1975. Contract W-7405-Eng-36. 24p. Dep. NTIS $5.00.

This report evaluates the efficiency of respirators as protection devices. The efficiency listed as a protection factor is concerned with the leakage of atmospheric contaminants inside the respiratory protective equipment. Experimental data concerning actual testing of personnel using respirators under controlled conditions are evaluated in relation to protection factors. Such data are extrapolated in relation to equipment which has not been completely evaluated to determine protection factors. A summary of protection factors for various respiratory protective devices is given. Information supporting the proposed protection factors is included in the report. Respirator-man testing procedures are described.

29077 METABOLISM AND MODELS OF ESTUARINE BAY ECOSYSTEMS AFFECTED BY A COASTAL POWER PLANT. McKellar, H. N. Jr. Gainesville, FL; Univ. of Florida (1975). 287p. University Microfilms Order No. 75-23,906.

Thesis (Ph. D.).

Effects of coastal power plants on an adjacent estuarine bay ecosystem at Crystal River on the west coast of Florida were evaluated with measurements and models to help understand relationships and predict the consequences of adding an additional power plant. The energy circuit model included metabolism, migrations, water exchange, and problems concerning interface of power plants and estuarine ecosystems. Field measurements were taken from the discharge and control bays. Comparisons and inferences were made concerning the effect of the power plant on ecosystem structure and function, especially production, community respiration, and nutrient relations. Plankton populations dominated total metabolism in the discharge bay while benthic systems dominated in the control bays. Annual average gross planktonic production was 3.06 and 1.93 g O_2/m^2/day in the discharge and control bays, respectively. Annual average planktonic chlorophyll in the discharge bay (2.97 g/m^3) was 34 percent higher than in the control bay (2.21 g/m^3). Zooplankton respiration was between 3 and 9 percent of total planktonic respiration and between 0.5 and 1.5 percent of total community respiration. Power plant influence on total community metabolism was small with less than 10 percent difference in annual averages (5.22 and 5.58 g O_2/m^2/day in the discharge and control bays, respectively).

29078 STRATOSPHERIC THICKNESS VARIATIONS OVER THE NORTHERN HEMISPHERE AND THEIR POSSIBLE RELATION TO SOLAR ACTIVITY. Zerefos, C. S.; Crutzen, P. J. (National Center for Atmospheric Research, Boulder, CO). J. Geophys. Res.; 80: No. 36, 5041-5043(20 Dec 1975).

Stratospheric temperatures at high latitudes in the 10- to 30-mbar layer are found to have been approximately in phase with the solar cycle during the period 1951-1970. These findings suggest an influence by galactic or solar cosmic rays. To study the possible effect of solar proton events on stratospheric temperatures, one of the largest known solar proton events, that of August 1972, is investigated. It is expected that after this event, significant changes in the temperature and ozone distributions should have taken place at high latitudes. This is tentatively confirmed by experimental data from the Canadian stations. It is tentatively proposed that variations in stratospheric temperatures and ozone concentrations at high latitudes over the solar cycle may be caused by similar variations in the production rates of nitric oxide by galactic or solar cosmic rays or a combination of both. (auth)

29079 SEARCH FOR NEUTRON GENERATION BY LIGHTNING. Fleischer, R. L. (General Electric Research and Development Center, Schenectady, NY). J. Geophys. Res.; 80: No. 36, 5005-5009(20 Dec 1975).

The possibility that neutrons are generated by natural lightning was tested by mounting neutron dosimeters on lightning rods atop a 300-m tower 16 km west of Champaign, Illinois, for a period of 219 days. Upper limits on the neutron generation from 156 individual strokes within 6 cm of the dosimeters gave greater than 3×10^9 thermal neutrons per stroke and greater than 2.5×10^{10} of 2.45-MeV neutrons. These values are too low to have detectable physical or chemical effects on geochronological systems that could potentially have allowed erosion rates or lightning history to be measured. The observed fluxes of fast neutrons are, however, consistent with the cosmic ray background. 14 references. (auth)

Minerals and Ores

Refer also to abstracts 28633, 29070, 29341, 32284, 32436, 32558, and 32571.

29080 (ETM-50) A PRELIMINARY SURVEY OF CANADIAN THORIUM RESOURCES AND POSSIBLE RECOVERY PROCESSES AND COSTS. McClure, R. J. (Eldorado Nuclear Ltd., Port Hope, Ontario (Canada)). 10 Mar 1975. 17p. INIS.

A study is provided of potential Canadian sources of thorium, methods for its recovery, and an analysis of the costs involved in producing suitable feed material for a nuclear fuel fabrication plant. Thorium in Canada is associated with uranium and niobium ores; reserves of monazite sands are minor. Thorium recovery from the barren solutions of uranium processing is a very attractive route and this study centers around such a concept. (INIS)

29081 (INIS-mf-1838) ADVANCES IN PROSPECTING FOR URANIUM. Toens, P. D. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Geology Div.). 1975. 20p. INIS.

From Institute for Mining and Metallurgy Symposium and Geological Society Summer School: Salisbury, Rhodesia (17 Feb 1975).

Some of the more recent developments in airborne and ground gamma-ray spectrometry are reviewed and also the use of alpha-particle detection methods in the location of hidden ore bodies. The use of the facility at the National Nuclear Research Center, Pretoria, for the calibration of gamma survey metres used in uranium prospecting to obtain semi-quantitative results in the field is brought to the notice of geologists engaged in prospecting for uranium. Certain criteria for the selection of exploration areas are briefly discussed and it is pointed out that the geochemical behavior of uranium provides the first indication of where uranium concentrations are likely to be retained in the late crystallizing phase of the magma and therefore often associated with leucocratic pegmatites. In the sedimentary rocks such as in the Karoo Supergroup, it has been found that uranium is on occasion concentrated in beds where sedimentation took place in a warm humid climate and under reducing conditions. The development of dark shales is therefore an important criterion in the investigation of sandstone deposits. It is also suggested that concentrations of uranium may have formed under physico-chemical conditions often proposed for stratabound copper deposits. It is considered that the recent discovery of uranium in the Karoo Supergroup in Angola, South West Africa and South Africa suggests that this formation warrants close investigation throughout Southern Africa. The possibility of locating uranium in calcretes or arkoses of Tertiary to Recent age is also briefly discussed.

29082 (INIS-mf-1870) URANIUM AND THE GENERATION OF POWER - THE SOUTH AFRICAN PERSPECTIVE. Von Backstroem, J. W. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Geology Div.). 1975. 29p. INIS.

Presidential address to the Geological Society of South Africa which will be published in greater detail at a later date.

Uranium requirements, uranium production capability and uranium reserves in the light of estimated energy forecasts for South

Africa and the western world are examined. The impact of breeder reactors, plutonium and uranium enrichment is also considered. The South African uranium situation and the exploration that is currently underway, is dealt with and some recommendations are made. These are followed by a list of characteristics and criteria that have a bearing on uranium mineralization in various formations in South Africa.

29083 (INIS-mf-1927) URANIUM AND ASSOCIATED NUCLEAR FUEL. (Ontario Ministry of Energy, Toronto (Canada); Ontario Ministry of Natural Resources, Toronto (Canada)). 26 Mar 1974. 41p. INIS.

The supply, demand, and control of uranium, thorium, and plutonium in Canada are reviewed. It is recommended that a joint federal provincial mechanism be established to control and integrate exploitation of nuclear fuels so as to meet national and provincial needs. In particular, Ontario and Ontario Hydro need committed supplies of uranium. Exploration and in particular foreign exploration capital should be encourage by clarification or relaxation of regulations on taxation, export, and ownership of uranium production.

29084 (IS-M-47) DIRECT DETERMINATION OF URANIUM IN ORES BY AN X-RAY EXCITED OPTICAL LUMINESCENCE TECHNIQUE. D'Silva, A. P.; Fassel, V. A. (Iowa State Univ. of Science and Technology, Ames (USA)). 1976. 6p. (CONF-760316-2). Dep. NTIS $3.50.

From international symposium on exploration of uranium ore deposits; Vienna, Austria (29 Mar 1976).

An x-ray excited optical luminescence method for U determination in ores is described in which the ore is blended with a phosphor-base mixture and heated for 30 min at 1200°C. In contrast to the usual luminescence emission under ultraviolet, the heated samples exhibit no luminescence under ultraviolet, but three broad bands in the 260 to 330 nm region are excited. The method can detect 5 ppM of U_3O_8 in a 25 mg ore sample. (JSR)

29085 (NBMG-Bull.-81) RADIOACTIVE MINERAL OCCURRENCES IN NEVADA. Garside, L. J. (Nevada Univ., Reno (USA). Mackay School of Mines). 1973). 121p. Nevada Bureau of Mines and Geology, Reno.

Four hundred forty-two natural radioactive occurrences of uranium and thorium are known in Nevada. They are found in every county, but are concentrated in the west-central part of the State. Nevada radioactive occurrences may be classified by mineralogic type and host rock lithology. Several combinations of host rock and mineralogic type contain most of the occurrences, while other combinations contain none. The largest number of occurrences are found in pre-Tertiary rocks associated with base and precious metals. Host rock types are subdivided into: Tertiary volcanic rocks, Tertiary sedimentary rocks, pre-Tertiary rocks, placer deposits, spring deposits and groundwater, and unknown rock types. Four mineralogic types are described: uranium associated with base and precious metals, radioactive pegmatites and plutonic accessory minerals, uranium minerals without associated metals, and anomalous radioactivity only. At least nine of Nevada's 17 counties are known to have produced uranium from about 28 mines. No production is known before 1951, and about 80 percent of the 137,792 lb of U_3O_8 produced has come from the Apex mine in Lander County. No production has been reported since 1968; and because of high haulage rates and long shipping distances, Nevada ore grades must be high to make a profit. The AEC estimates Nevada's uranium reserves at 14,000 tons of ore at a grade of 0.33 percent U_3O_8, but this figure is mainly the residue (reserves minus production) from earlier reserve estimates made during periods of higher prices and haulage allowances. A much lower estimate of Nevada reserves is expected following property examinations now in progress by AEC. Possible large, low-grade resources of uranium in Nevada may be found in phosphates, black shales, and porphyry copper deposits. Any uranium produced from such deposits would probably be as a by-product. (LK)

29086 (SAND-75-5991) PULSED NEUTRON URANIUM BOREHOLE LOGGING WITH EPITHERMAL NEUTRON DIEAWAY. Bivens, H. M.; Smith, G. W.; Jensen, D. H.; Jacobs, E. L.; Rice, L. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1976. 16p. (CONF-760316-1). Dep. NTIS $3.50.

From international symposium on exploration of uranium ore deposits; Vienna, Austria (29 Mar 1976).

Both prompt fission neutrons and delayed fission neutrons can be used for logging uranium boreholes. This paper describes a uranium logging system, using a pulsed neutron generator, which detects and assays uranium by the measurement of prompt fission neutrons. The system development began with a feasibility study which included experimental measurements in uranium test pits at Grand Junction, Colorado, and computer calculations of the epithermal neutron return in the presence of uranium. A Monte Carlo neutron transport code and a 21 group, one-dimension, time-dependent, discrete-ordinates neutron transport code have been used to calculate the effects of borehole geometry and rock matrix parameters on the epithermal neutron dieaway. Some experimental and analytical results are described. A prototype logging probe, 70 mm in diameter, was built and field evaluation began in January 1976. The physical and operational characteristics of the probe and the uphole equipment are described. Some logging results are shown which were obtained in an area in which disequilibrium is known to exist. Although the field experience with the probe has been brief, the results have been significant. They imply that a relatively accurate assay of low-grade uranium ore can be obtained with this method provided that proper calibration factors are determined, and a neutron output of about 10^{10} n/s is used. A neutron tube is being developed for uranium logging that will generate 10^{10} n/s when operated at 100 pulses per second. (auth)

29087 MINERAL RESOURCES AND THE ENVIRONMENT. Supplementary Report: Reserves and Resources of Uranium in the United States. Washington, DC; National Academy of Sciences (1975). 245p. $7.00.

Estimates of uranium reserves and resources are summarized as assessed. These estimates are based on a reappraisal of existing available data from the Atomic Energy Commission, published reports on U resources, and a 2-day conference held in Albuquerque, New Mexico in December, 1974 (list of participants and papers presented included in the appendix to this report). The rate at which uranium can be supplied from these resources is considered for the period 1975-2000, with particular emphasis on the period 1975-1990. The merits of commitment to the nuclear option are not considered; however, information on which decisions on commitment must be based is included. Actions necessary to assure adequate supplies of uranium if U-fueled power is to play a significant role in the national energy economy are suggested. All estimates call for rates of uranium production significantly higher than the present rate. Certain conclusions and recommendations consistent with the estimates and findings of this report are set forth. (BLM)

29088 URANIUM DEBATE. Bird, J. R.; Gemmell, W. Aust. Phys.; 12: No. 9, 115-120(Sep 1975).

This introductory digest of information and references relevant to the question as to whether to mine, process, and sell Australian uranium was prepared as a starting point for those who wish to brief themselves on these problems. It is not intended as an answer to the questions involved, but as a basis for further discussion. The numbers quoted throughout are meant to illustrate magnitudes since, in most cases, rapid changes are occurring and different results can be found in different references. (auth)

29089 WYOMING URANIUM MINERS SET SIGHTS ON HIGHER PRODUCTION. White, L. Eng. Min. J.; 176: No. 12, 61-71 (Dec 1975).

The rising price of U_3O_8 due to current shortage of supply and stiff environmental regulations on the uranium mining serve as grounds for caution in assessing the future of the uranium industry. Some projections of the need for doubled uranium production in the next 5 years have sparked much exploration and mining in Wyoming. Currently working or near-working mining operations are discussed briefly. The discussions are divided as to the company carrying out the operation—from Exxon to small drilling contractors. (BLM)

29090 BASIS OF EVALUATION OF RADIOACTIVITY IN URANIUM MINES. Scalaev, I. L.; Byhovskii, A. V.; Saltykov, L. D.; Pavlov, I. V.; Komodov, A. A.; Siskin, V. I. Gig. Sanit.; No. 10, 41-46(Oct 1974). (In Russian)

It is shown that radioactivity in uranium mines is essentially a function of the latent energy of airborne daughter products of radon. The optimum volume of information necessary in order to define the noxiousness of the radioactive environment (external radiation, atmospheric contamination by α-emitting radioisotopes and by radon and its daughters), and to determine the protective measures to be taken are indicated. (CIS Abstr. Vol. 2)

29091 RADIOGEOKHIMICHESKIE ISSLEDOVANIYA. Metodicheskie Rekomendatsii. (Radiogeochemical Investigations. Recommendations on Exploration Techniques). Moscow; Ministerstvo Geologii SSSR (1974). 148p. (In Russian)

248 refs.; 44 figs.; 18 tables.

A method for carrying out the most important types of radiogeochemical studies, sampling of rocks and making γ-spectrometric measurements in the field, and methods for determining the content of radioactive elements are presented. Radiogeochemical features of geological formations of folded regions are characterized, and the distribution of U and Th in minerals, rocks,

geological formations, structural formation complexes, and lithosphere strata are considered. (tr-auth)

29092 FIELD RESULTS OF THE NATURAL GAMMA RAY SPECTRALOG. Wichmann, P. A.; McWhirter, V. C.; Hopkinson, E. C. (Dresser Industries, Inc., Houston, TX). pp 0.1-13 of Transactions of the SPWLA Sixteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts Inc. (1975).

From 16th annual logging symposium; New Orleans, Louisiana, USA (4 Jun 1975). See CONF-750643-.

The natural gamma ray Spectralog was first run by Dresser Atlas in the late 1960's and described in the literature in 1971 by Lock and Hoyer of Exxon Research. Since that time additional development of the system has resulted in improved calibration that gives quantitative definition of the three most common sources of natural radioactivity, the uranium and thorium series and potassium-40. This is accomplished through spectral stripping processes and a more sophisticated computer panel. A number of additional logs have been run, several of these being supported with quantitative core analysis of the radioactive components. Natural gamma ray logs are consistently the best single source of clay content definition. While much remains to be learned, these advances in studying the natural spectrum promise to further refine our approaches to this problem. In addition, the Spectralog also offers solutions to certain mineral exploration and evaluation problems, correlation refinements, explanation of some geologic sedimentation processes and a probable quantitative solution to the occurrence of mica or feldspar in productive horizons. (auth)

29093 DISTRIBUTION OF URANIUM- AND TIN DEPOSITS IN THE MAJOR GEOTECTONIC STRUCTURES AND ORE FORMATION EVOLUTION. Evastrakhin, V. A. (Ministerstvo Geologii SSR, Moscow). Sov. Geol.; No. 1, 41-59(Jan 1975). (In Russian)

From English translation see the journal Int. Geol. Rev.

29094 URANIUM PROSPECTING REVIVING WITH HIGHER PRICES EXPECTED. Nucl. Can./Can. Nucl.; 14: No. 6, 4(Jun 1975). (In English, French)

The projected increase in world nuclear generating capacity from about 50,000 MW(e) in 1974 to between 2.5 and 4 million MW(e) in year 2000 has greatly increased the demand for uranium. Possible future growth in demand from about 30,000 tons of uranium oxide in 1975 to between 70,000 and 80,000 in 1980 and to between 400,000 to 490,000 tons in 2000 has renewed the interest of Canadian prospectors in new uranium deposits. With incentive of higher prices, perhaps in the range of $15 to $20 a pound, new mines are expected to be found and brought into production. (RA)

29095 MEASUREMENT OF THE FREE FRACTION PRESENT IN THE AIR OF A LABORATORY URANIUM MINE. Duport, P. (CEA, Fontenay-aux-Roses, France); Madelaine, G.; Renoux, A. Chemosphere; 4: No. 5, 283-288(Oct 1975). (In French).

The radioactivity of the atmosphere of a uranium mine is due almost exclusively to the active deposition of radon (RaA, RaB, RaC) which is found either in the free form or fixed to inert aerosols. The maximum permissible concentration (MPC) set by the ICRP for the protection of workers is given by the equation where MPC is equal to 3×10^{-6} divided by $1 + 1000\ f\ \mu Ci\ cm^{-3}$, f being the free fraction. In order to determine f, here defined as the free fraction of RaA, five different methods based on the Brownian movement of particle were employed. Then methods include the use of the Mercer impact apparatus diffusion batteries and capture by metallic rods. The five methods gave comparable results with an average value of the order of 0.30, with however a wide spread. Several reasons are suggested for this. One suggestion is that the work was done in a laboratory mine with constant ventilation. In the case of the mercer impact, the activity collected in the plagues was very low which gave rise to statistical errors. The measurements were spread out in time, therefore dependent or unavoidable variations of the initial conditions. It is necessary to choose an apparatus which is best adapted for measurements of f in a working mine. In this case f will be low because of strong turbulence and effective ventilation. The apparatus chosen should therefore give a direct measurement of the free RaA with as high counts as possible. The metal rods apparatus seems best suited to meet these criteria. Average values of the free fractions of RaB(f_B) and RaC(f_C) were determined with $f_B = 0.16$ and $f_C = 0.15$, showing that the concentration of suspended ultrafine particles of RaB and RaC is not negligible in a non-working mine. A theoretical justification of the results is in progress. (FMM)

29096 NUCLEAR DIMENSION. Grenon, M. Rev. Energ.; 26: No. 274, 726-731(Jun 1975). (In French).

A prospective evaluation of nuclear energy development until next century is presented, and three basis hypotheses concerning worldwide population, energy consumption, and nuclear options are analyzed. (FR)

29097 LINE TECHNOLOGY OF SUBTERRANEAN ORE EXTRACTION BY MEANS OF NUCLEAR EXPLOSIONS. Gushchin, V. V.; Vasin, K. D.; Nifontov, B. I.; Odrov, Yu. L.; Myasnikov, K. V.; Koltsov, V. M.; Kornev, G. N.; Degtyarev, V. A. At. Energ. (USSR); 40: No. 2, 162-172(Feb 1976). (In Russian)

The basic principles of a line technology of extracting firm ores, including break-up of ore by means of subterranean nuclear explosions, the removal of ore from sorting blocks by means of vibrator feeders, and transporting it to intermediate levels via a new type of belt conveyor on mobile supports are considered. A method of breaking up ore by nuclear explosions on reflecting surfaces is proposed to obtain a more uniform division of ore, increase the output of fragmented ore per unit capacity, and to preserve mining output. The basic principles of designing a system of mining based on a line technology are formulated and one variant of such a system is presented. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 28638, 29281, 29704, and 29792–29794.

29098 (INIS-mf-) APPLICATION OF INTERNATIONAL MARITIME PROTECTION CONVENTIONS TO RADIOACTIVE POLLUTION. Stein, R. M.; Walden, R. M. (International Atomic Energy Agency, Vienna (Austria)). 1975. 24p. (In French). INIS.

From colloquium on nuclear law and law of the sea; Paris, France (12 Jun 1975).

Colloquium organized by the Centre d'Etudes et de Recherches de Droit International and the Centre d'Etudes du Droit de l'Energie Atomique.

The application of international maritime protection conventions to radioactive pollution is discussed with particular emphasis on the 1972 London Convention on prevention of marine pollution by dumping of wastes and other matter. Under that Convention, wastes are divided into three categories according to their radioactivity. High level wastes, whose dumping is prohibited, and low level wastes, which require a special dumping permit, are studied on the basis of definitions established by the International Atomic Energy Agency. Mention is made of the IAEA-recommended procedures for issue of the specific dumping as well as of the exceptions provided for ships and aircraft enjoying State immunity and cases of force majeure or emergencies. Also dealt with are the other international Conventions applying to prevention of radioactive marine pollution. (FR)

29099 ROLE OF FALLEN LEAVES IN THE VERTICAL MIGRATION OF ^{90}Sr IN SOIL. Molchanova, I. V.; Chebotina, M. Ya. (Inst. of Plant and Animal Ecology, Sverdlovsk, USSR). Sov. J. Ecol. (Engl. Transl.); 6: No. 2, 149-151(1975).

Translated from Ekologiya; 6: No. 2, 78-80(1975).

The data cited show that the presence of a layer of decomposing fallen leaves on the soil surface facilitates vertical migration of Sr^{90}. Moreover, fallen birch leaves have a greater influence on migration of the radioactive element than pine needles. This corresponds to the higher rate of decomposition for birch leaves, as compared with pine needles: The decrease in weight of birch leaves during the experiment was 53%, but for pine needles only 32%. Moreover, laboratory experiments with plant extracts show that fallen birch leaves release a larger quantity of Ca, Mg, and organic substances into a solution on decomposing than do pine needles. We may presume that the increased mobility of Sr^{90} under the influence of decaying leaves is due both to the desorbing activity of cation-macroanalogs (Ca and Mg) and to its interaction with the mobile fractions of organic substances which form as the leaves decompose. (auth)

29100 IMPACT OF THERMAL AND RADIOACTIVE EFFLUENTS ON A TROPICAL NEARSHORE ECOSYSTEM. Patel, B.; Balani, M. C.; Patel, S.; Panday, V. K.; Soman, S. D. (Bhabha Atomic Research Centre, Bombay). pp 17-34 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

The paper reviews and discusses the effects of heated effluents on the bioaccumulation of radionuclides and possible thermal

potentiation of the chromium effect on three species of lamellibranchs, the blood clam Anadara granosa, the venerid clam Katelysia opima and the oyster Crassostrea gryphoides. The impact of thermal discharges on the uptake of caesium, cobalt, iodine and zinc radionuclides was studied exposing bivalve populations in a 1 km long discharge canal of a BWR nuclear power station on the west coast of India. The effect of temperature on feeding rates, since feeding ultimately leads to bioaccumulation of nuclides, of blood clam A. granosa was studied under laboratory conditions. The filtration rates were temperature dependent over the range 21 to 31°C. The thermal potentiation of the chromium effect on the rate of filtration is discussed in light of this metal's toxic effect. (auth)

29101 BIOLOGICAL EFFECTS OF SIMULATED DISCHARGE PLUME ENTRAINMENT OF INDIAN POINT NUCLEAR POWER STATION, HUDSON RIVER ESTUARY, USA. Lanza, G. R.; Lauer, G. J.; Ginn, T. C.; Storm, P. C.; Zubarik, L. (Inst. of Environmental Medicine, New York). pp 95-126 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

Laboratory and field simulations of the discharge plume entrainment of phytoplankton, zooplankton and fish were carried out at the Indian Point Nuclear Station, Hudson River estuary, USA. Phytoplankton assemblages studied on two dates produced different response patterns measured as photosynthetic activity. Chlorophyll-a levels did not change following simulated entrainment. Possible explanations for the differences are discussed. The two abundant copepods Acartia tonsa and Eurytemora affinis appear to tolerate exposure to discharge plume ΔT without adverse effects. Copepods subjected to plume entrainment may suffer considerable mortality during periods of condenser chlorination. In general, the amphipod Gammarus spp. did not appear to suffer significant mortality during simulated entrainment. Juvenile striped bass, Morone saxatilis, were not affected by simulated plume transit before and during plant condenser chlorination; however, a simulated "worst possible case" plume ΔT produced statistically significant mortalities. (auth)

29102 TECHNIQUES FOR RAPID DETERMINATION OF EFFECTS OF SYNERGY BETWEEN RADIONUCLIDES AND POLLUTANTS. Saas, A.; Grauby, A. (CEA-CEN de Cadarache, St-Paul-lez-Durance, France). pp 145-154 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975). (In French)

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

The authors present a number of chromatographic techniques for rapid determination of synergy between radionuclides and various compounds in water. The first technique consists in studying how the chemical equilibrium of iodine varies in the presence of various organic and mineral compounds. The second makes it possible to define the effects of synergy within a given hydrographic basin. A third technique deals with the effects of synergy in ground water in the presence of various types of irrigation water. Finally, to complete this set of techniques, the authors define the mobility potential of a radionuclide in a given aqueous effluent. (auth)

29103 TRACE ELEMENT INTERACTIONS IN THE ESTUARINE ZONE OF THE ANASCO RIVER, PUERTO RICO. Wolfe, D. A. (National Marine Fisheries Service, Beaufort, NC); Forster, W. O.; McClin, R.; Lowman, F. G. pp 155-178 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

The Anasco River on the west coast of Puerto Rico is highly stratified near the mouth, so that gradients from fresh water to full oceanic salinity occur abruptly over short distances, both vertically and horizontally. To study the behavior of trace elements and radioisotopes in this compact estuarine zone, bottom sediments and river water from different depths in the stratified layers were sampled periodically at several stations during 1969-1970. Stable iron, manganese, aluminium, scandium and cobalt were analyzed by neutron activation in the sediment cores and in suspended particulate matter retained on 5-8 μm filters upon successive filtration of the water. The filtered water samples were analyzed only for soluble iron. The distribution and concentrations of these stable elements were examined for seasonality and salinity-dependency, and were compared with the distribution of radioisotopic tracers in experimental river water-seawater mixtures. These mixtures consisted of unfiltered Anasco River spiked with ^{155}Eu, ^{125}Sb, ^{113}Sn, ^{110}Ag^{m}, ^{65}Zr, ^{60}Co, ^{59}Fe and ^{54}Mn and then mixed in different proportions with filtered seawater to produce a stepwise salinity gradient from 100% fresh water to 95% seawater. After 5-10 days, the mixtures were fractionated, and the radioisotopes were determined in the soluble phase, the suspended particulate and the sedimented material. Concentrations of aluminium, scandium and iron in the particulate matter recovered on 0.45 μm filters were inversely related to salinity whereas manganese and cobalt showed no consistent correlation to salinity. In the tracer experiments ^{54}Mn, ^{59}Fe, ^{65}Zn, ^{110}Ag^{m} and ^{155}Eu showed higher fractional solubilities as the salinity increased. The field results for iron and the radioisotope experiment were consistent with both the formation of suspended particulate material at low salinities and the desorption of trace metals from suspended material as salinity increased. These processes appeared most important below 15‰ salinity. (auth)

29104 CHARACTERISTICS OF COASTAL CIRCULATION AFFECTING THE TRANSPORT AND DISPERSION OF MATERIAL RELEASED FROM THE NUCLEAR INDUSTRY. Blanton, J. O. (Energy Research and Development Administration, Washington, DC). pp 255-268 of Combined Effects of Radioactive, Chemical, and Thermal Releases to The Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

Our knowledge of circulation in the coastal zones of oceans and inland seas is hindered by lack of detailed observations in these regions. The shallow zone within a few miles of the coast is the region where the impact of nuclear facilities is likely to be felt. The studies reported here represent an attempt to obtain the spatial and temporal resolution necessary to describe the characteristics of circulation in the coastal zone. These studies were conducted in Lake Ontario, one of the Laurentian Great Lakes, and they are thought to be particularly relevant to most large lakes and inland seas such as the Baltic Sea. Some relevance to shallow continental shelf areas is also noted. Data obtained from moored current meters during thermally stratified conditions indicate the existence of a nearshore region extending some 8 to 10 km from the shore where upwelling and downwelling of the thermocline is confined. The root-mean-square (rms) speeds of the wave-like currents near the local inertial period (17 hours) are a small fraction of the "along-shore" velocity component in this nearshore zone. Beyond this region, the rms speeds dominate the flow regime and are typically 2 to 10 times the mean velocity. Simple momentum arguments suggest that the time for adjustment decreases as water depth nearshore decreases. The most important lesson to be gained by these studies is that current measurements at a single point are often misleading. The characteristics described here cannot be defined without closely-spaced synoptic current measurements over a coastal region. (auth)

29105 ZINC IN POLLEN AND ITS INCORPORATION INTO SEEDS. Polar, E. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). Planta; 123: No. 1, 97-103(1975).

A study on the distribution of radioactive zinc (^{65}Zn) in flowers of Vicia faba L. and Nicotiana tabacum L. showed the highest activity, expressed as cpm/mg dry weight, in pollen. Also, using a histochemical method, it was observed that a portion of the naturally occurring zinc present in pollen grains was transferred into their growing tubes during germination. Calculations based on the specific activity in ^{65}Zn-labelled pollen grains and in seeds from flowers pollinated with this pollen showed that about 68% of the radioisotope content of the pollen was incorporated into the seeds. The significance of these results and the possible role of zinc in fertilization are discussed. (DE)

29106 CHARACTERISTIC OF THE RADIOACTIVE CONTAMINATION OF THE VISTULA WATER. Kwapulinski, J. Gaz, Woda Tech. Sanit.; 47: No. 9, 302-305(1973). (In Polish).

Results of measurement of the specific radioactivity β and Sr-90 content in the Vistula water in 1969 to 1971 are given. The range of the radioactivity variation, the statistic mean, coefficient of the specific radioactivity variation and of the dry residue after calcination, have been given. The precipitation effect on the radioactivity variation has been described, and the correlation factors have been given. (auth)

29107 MERCURY AS A MARINE POLLUTANT. Keckes, S.; Miettinen, J. K. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 37, 1-44(1973).

The biogeochemistry of stable and radioactive mercury is discussed with regard to properties of mercury, occurrence, dis-

tribution, circulation and transformation, microbial transformation, transformation by plants and animals, accumulation by fish, and transfer route. Uses of mercury in agriculture and industry and environmental mercury pollution from chlorine and cellulose industries are discussed. Results of studies on harmful effects of mercury pollution in Sweden and other countries are reported. Other studies are described on toxic effects of mercury on aquatic organisms, teratogenic effects, and genetic effects. (HLW)

29108 MERCURY AS A HYDROSPHERIC POLLUTANT. I. ACCUMULATION AND EXCRETION OF $^{203}HgCl_2$ IN TAPES DECUSSATUS L. Uenlue, M. Y.; Heyraud, M.; Keckes, S. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 38, 1-9(1973).

Some aspects of metabolism of mercury in the mollusc, Tapes decussatus, related to potential hazards of environmental pollution by mercury are described. Mercury-203 was used in the form of chloride. Mercury accumulated rapidly in Tapes from seawater and in one day the animals contained per unit weight ten times as much mercury as the environment. When the exposure was longer, the accumulation was reduced. In 14 days the visceral organs contained the major part while the muscles contained less than 2% of the total. The speed of loss of accumulated mercury depends on the mode of penetration. The retention is greatest following injection into the foot muscle, about 25% of the injected mercury is lost in two months. The retention of mercury from seawater or from the food chain is not very strong.

29109 SPECIFIC ACTIVITY OF RADIONUCLIDES SORBED BY MARINE SEDIMENTS IN RELATION TO THE STABLE ELEMENT COMPOSITION. Duursma, E. K. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 33, 57-71(1973).

The problem investigated is whether the binding of radionuclides to marine sediments in a waste disposal area can be predicted from studies of the trace metal contents of the sediments. To evaluate this, the experimentally determined distribution coefficients of various radionuclides and the existing corresponding stable isotope distribution were compared for different marine sediments of the major ocean basins. The ratio of the distribution coefficient of the radionuclide to that of its stable counterpart was considered to be a measure of the amount of the stable isotope available for exchange with the radionuclide in seawater. The ratios were normally low, but ranged from about 0.1 to 100% for the different elements and sediments tested. The practical application for waste disposal evaluations is that the ratios estimated for a particular area might be used for a first approximation of the maximum amount of radionuclides that might be held by the sediment at a given specific activity in the seawater.

29110 ENVIRONMENTAL BEHAVIOR OF RADIOCOBALT AND RADIOSILVER RELEASED FROM NUCLEAR POWER STATIONS INTO AQUATIC SYSTEMS. Fukai, R.; Murray, C. N. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 40, 217-242(1972).

To deduce the general characteristics of the behavior of radiocobalt and radiosilver released from nuclear power stations into the aquatic environment, the release situations of several existing power stations together with field data obtained to date on these and other releases are systematically assembled and reviewed. These data indicate that, although the major sink for radiocobalt is bottom sediments, some fractions tend to recycle into a soluble phase and go through complicated processes such as hydrolysis, inorganic and organic complex formation, adsorption-desorption with suspended particles and bottom sediments, etc. In the case of radiosilver the complex formation with chloride ions in the seawater medium seems to be important in maintaining this element in solution, while there are practically no data available for freshwater systems. Since these reactions have pronounced effects on the availability of the radionuclides to aquatic biota, possible speciation equilibria and related geochemical behavior of cobalt and silver radionuclides in natural waters are discussed in detail on the basis of the data obtained by various workers as well as by the present authors from laboratory experiments and field measurements. An attempt is made to evaluate and compare the importance of various processes under natural conditions. Finally, the accumulation of radiocobalt by the aquatic biota is reexamined from the viewpoint of concentration factor. Revised concentration factors are presented for some groups of marine organisms.

29111 CONCENTRATION EFFECTS ON ^{137}Cs, ^{65}Zn, ^{60}Co, AND ^{106}Ru SORPTION BY MARINE SEDIMENTS, WITH GEOCHEMICAL IMPLICATIONS. Aston, S. R.; Duursma, E. K. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 31, 225-240(1974).

The uptake of ^{137}Cs, ^{65}Zn, ^{106}Ru and ^{60}Co by several types of marine sediment was studied by a simple laboratory technique. The reactions were measured as functions of equilibration time, carrier concentration, sediment concentration and salinity. Large values of the distribution coefficients of these radioisotopes at sediment concentration of 0.05 mg/ml were interpreted as nucleation, respectively aggregation of particulate forms of the radioisotopes by sediment particles. Constant distribution coefficients are found at higher sediment concentrations where nucleation is masked by adsorption onto the sediment particles. ^{137}Cs was found to have an uptake proportional to the illite content of the sediments, probably involving an ion-exchange reaction with potassium. The other radioisotopes showed less specific adsorptions. All radioisotope sediment reactions could be represented by the Freundlich isotherm model. The consequences of the uptake, especially the high particulate proportions of the radioisotopes at low sediment concentrations, were discussed with regard to the supply of trace elements to bottom sediments in the open ocean and the availability of artificially introduced radioactivity to filter feeders and benthic life.

29112 ADSORPTION-DESORPTION EQUILIBRIA OF SOME RADIONUCLIDES IN SEDIMENT-FRESH-WATER AND SEDIMENT-SEAWATER SYSTEMS. Murray, C. N.; Murray, L. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 36, 105-124(1973).

The present paper describes experiments that were carried out to investigate the uptake of certain radionuclides on freshwater sediments in river water (adsorption) and their subsequent release from the sediments to the seawater (desorption). It was found that for the radionuclides studied, ^{60m}Co, ^{65}Zn, ^{110m}Ag, their behavior was very individual. Laboratory results suggest that certain factors strongly affect the adsorption-desorption characteristics of the sediment. The influence of important factors such as the pH of the river, estuary and seawater, the concentration of sediment and trace element in the river water, the speciation of the trace element, the mineralogy of sediment, the formation of particulate material in the river water and flocculation of this by sediment in the estuary and sea, and salinity effects on desorption, are discussed. From a knowledge of these factors, it is possible to predict, as a first approximation, for a given sediment the amount of radionuclide that will be taken up by a given weight of fresh-water sediment in a very simple river system under equilibrium conditions. When this sediment reaches the marine environment the amount of desorbed radionuclide can be calculated. An example of a predictive calculation for adsorption-desorption of Var river sediment is given for conditions of pH, sediment load and tracer concentration that are typically found in this system.

29113 INTERCALIBRATION OF METHODS FOR RADIONUCLIDE MEASUREMENTS ON A MARINE SEDIMENT SAMPLE. Fukai, R.; Statham, G. A.; Ballestra, S.; Asari, K. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 45, 313-335 (1974).

The results reported in the intercalibration of methods for radionuclide measurements on a marine sediment sample are surveyed. The preparation of the marine sediment sample, its homogeneity and the procedures for intercalibration are also described. Forty-four laboratories from 20 countries participated in this intercalibration exercise during 1972-73. The survey of the reported results shows that, although the scatter of the data for the sediment measurements is still considerably large, especially for ruthenium-106, the comparability of the results obtained by different laboratories has been improved, as a whole, when compared with that for the seaweed sample. Nevertheless, a comparison of the results obtained by Ge(Li) γ-spectrometry with other methods indicates that there are still problems of calibration of Ge(Li) γ-spectrometers in some laboratories due, perhaps, to the radionuclide standards used and/or the procedures of instrument calibration. The probable concentrations estimated by various statistical treatments of the reported data are presented for major radionuclides reported, such as strontium-90, ruthenium-106, caesium-134, caesium-137 and cerium-144.

29114 EXPERIMENTAL STUDIES ON CADMIUM FLUX THROUGH MARINE BIOTA. Fowler, S. W.; Benayoun, G. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 44, 159-178(1974).

The role of mussels (Mytilus galloprovincialis) and benthic shrimp (Lysmata seticaudata) in the cycling of cadmium in the marine environment was examined. Results from ^{109}Cd uptake experiments indicated that steady state between water and the organisms was not reached after 2 months. Concentration factors computed at this time were 130 and 600 in whole mussels and shrimp, respectively. Concentration factors based on stable cadmium concentrations were several times higher, indicating incomplete equilibration between ^{109}Cd and stable cadmium in the organisms. Mussels had the highest ^{109}Cd concentrations in the

viscera with lesser amounts in muscle, mantle, gills and shell, respectively. The highest ^{109}Cd concentration in shrimp was also found in the viscera, followed by exoskeleton, muscle and eyes. Relative differences between stable and radiocadmium content of certain tissues are discussed. Increased cadmium uptake at higher temperatures was noted in shrimp, whereas uptake by mussels was unaffected by temperature. The uptake of cadmium was directly proportional to the cadmium content in seawater; however, accumulation was unaffected by varying the zinc concentration. Shrimp tended to lose cadmium faster at higher temperatures; however, differences were not significant over the 2 months loss period. Shrimp maintained in a flowing seawater system retained an average 55% of their original ^{109}Cd body burden after 8 months. The biological half-life, computed over a 7 month period, was 378 days. The relatively slow loss of ^{109}Cd from mussels was not affected by either the levels of zinc in their tissues or zinc concentration in the surrounding seawater. Mussels maintained at a field station lost significantly less ^{109}Cd than a similar group held in the laboratory flowing seawater system during the first 3 months.

29115 RISK ASSESSMENTS FOR THE DISPOSAL OF HIGH LEVEL RADIOACTIVE WASTES. Smith, C. F. Los Angeles; Univ. of California (1975). 186p. University Microfilms Order No. 76-1167.

Thesis (Ph. D.).

The risks associated with the disposal of high level wastes derive from the potential for release of radioactive materials into the environment. The assessment of these risks requires a methodology for risk analysis, an identification of the radioactive sources, and a method by which to express the relative hazard of the various radionuclides that comprise the high level waste. The development of a methodology for risk analysis is carried out after a review of previous work in the area of probabilistic risk assessment. The methodology suggested involves the probabilistic analysis of a general accident consequence distribution. In this analysis, the frequency aspect of the distribution is treated separately from the normalized probability function. At the final stage of the analysis, the frequency and probability characteristics of the distribution are recombined to provide an estimate of the risk. The characterization of the radioactive source term is accomplished using the ORIGEN computer code. Calculations are carried out for various reactor types and fuel cycles, and the overall waste hazard for a projected thirty-five year nuclear power program is determined. (Diss. Abstr. Int., B)

29116 UPTAKE OF BOMB-PRODUCED CARBON-14 BY THE PACIFIC OCEAN. Linick, T. W. San Diego, CA; Univ. of California (1975). 270p. University Microfilms Order No. 76-2307.

Thesis (Ph. D.).

Collection of seawater samples for carbon-14 analysis was performed from 1957 through 1972. The dissolved inorganic carbon was extracted on board the ships and returned to the laboratory for processing. Samples were analyzed for carbon-14 by gas proportional counting of acetylene prepared by conversion of carbon dioxide to acetylene via lithium carbide. Carbon-14 results are reported for 312 surface and 96 sub-surface Pacific Ocean samples and for 34 surface and 53 sub-surface Indian Ocean samples. The precision of measurements was generally from 0.5 to 1.5 percent (one-sigma). The purpose of the seawater measurements was to determine the distribution of bomb carbon-14 in the surface of the Pacific and Indian Oceans, the change in carbon-14 concentration with depth, and the rate of uptake of bomb carbon-14 by the oceans. The oceans are the largest reservoir of exchangeable carbon. The CO_2 of the atmosphere exchanges with that of the sea through molecular exchange. In the surface Pacific, a strong latitudinal variation in carbon-14 concentration was found. By 1971, maxima of about 25 percent above pre-bomb levels were found at mid-latitudes of both hemispheres; this finding is attributed to relatively weak vertical mixing in the gyral circulation systems. A 1971 equatorial excess of only about 11 percent is caused by upwelling of sub-surface water and mixture of low carbon-14 Peru Current water into the equatorial system. South of the Antarctic Convergence surface radiocarbon levels rapidly decrease. To the North of the North Pacific gyre maximum, carbon-14 levels show a minimum at about 40^0N, apparently due to an influx of low carbon-14 water from north of Japan. Levels then rise to a maximum at 45^0N to 48^0N, before decreasing further north. (Diss. Abstr. Int., B)

29117 THEORETICAL, EXPERIMENTAL, AND FIELD STUDIES CONCERNING REACTIONS OF RADIOISOTOPES WITH SEDIMENTS AND SUSPENDED PARTICLES OF THE SEA. III. Applications to Field Studies. Duursma, E. K. (International Atomic Energy Agency, Monaco); Eisma, D. Radioact. Sea; No. 32, 265-324(1974).

The sediment samples were obtained from the sea floor of the three oceans, the Arctic Seas, the Baltic Sea, the North Sea, the Mediterranean, the Black Sea and the Red Sea. The radionuclides studied were ^{90}Sr, ^{137}Cs, ^{65}Zn, ^{60}Co, $^{95}Zr/Nb$, ^{54}Mn, ^{59}Fe, ^{106}Ru, ^{147}Pm and ^{144}Ce. Only with Mediterranean sediment the behaviour of ^{240}Pu, ^{45}Ca, ^{86}Rb and ^{210}Pb was investigated. The sediment composition has been investigated for clay minerals in different grain-size fractions, for median grain size and sorting, for specific surface, for exchange capacity, for organic matter, and for the extractability of the ions Na, K, Ca, Mg and Fe with acetic acid NH_4-acetate, 0.1 N HCl, 20% HCl, and concentrated HCl. Each of the parameters of the sediment composition has been related to the distribution coefficient of sorption which characterizes the radionuclide sediment behaviour. The best relationships were found with the base-exchange capacities and the specific surface values of the sediments. For the whole group of sediments, the ratio between the distribution coefficient and the base-exchange capacity increases in the order ^{90}Sr, ^{45}Ca, ^{239}Pu, ^{137}Cs, ^{65}Zn, ^{86}Rb, ^{60}Co, $^{95}Zr/Nb$, ^{54}Mn, ^{59}Fe, ^{106}Ru, ^{210}Pb, ^{147}Pm, ^{144}Ce; there is, however, also an increasing deviation from the mean ratio. Strontium sorption is not related to the $CaCO_3$ content of the sediment; ^{137}Cs sorption has some relationship with the potassium and illite contents of the sediment.

29118 INTERCALIBRATION OF METHODS FOR MEASURING FISSION PRODUCTS IN SEAWATER SAMPLES. Fukai, R.; Ballestra, S.; Murray, C. N. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 35, 3-27(1973).

To examine the present-day comparability of fission product measurements on seawater samples with the aim of achieving better comparability in the future, an intercalibration exercise was organized by the Monaco Laboratory in 1970-71; two kinds of homogeneous seawater samples contaminated with various radionuclides under natural conditions at monitoring levels were distributed to laboratories around the world—46 laboratories reported the results of measurements on fission products in these samples. In this paper a survey made on the reported results is presented together with the results of homogeneity tests of the samples. The "preferred values" for strontium-90, ruthenium-106, caesium-134 and caesium-137 are estimated for these samples by statistical treatments of the obtained results. The scatter of the results is less pronounced for strontium-90 and caesium-137 than for zirconium-niobium-95, ruthenium-106, caesium-134 and cerium-144. For ruthenium-106 in the higher level sample, the results are especially noteworthy, being spread over almost two orders of magnitude. This seems to relate to the incapability of some methods to measure different chemical forms of this radionuclide occurring in seawater. Specific observations made on the results for each radionuclide as well as general remarks on the reported results are also given.

Atmosphere

Refer also to abstracts 29174, 29176, 29280, 29283, 29442, 29613, 29674, and 29767.

29119 (COO-2450-3) IODINE-129: A STUDY OF ITS TRANSPORT IN THE ENVIRONMENT AND DISTRIBUTION IN BIOLOGICAL SYSTEMS. Progress Report, June 1, 1975–May 31, 1976. Manuel, O. K. (Missouri Univ., Rolla (USA). Dept. of Chemistry). Feb 1976. Contract E(11-1)-2450. 21p. Dep. NTIS $3.50.

During this second year of our study on the transport and distribution of ^{129}I, most of our efforts have been given to analyses of iodine in representative samples of milk, surface water, precipitation, plants, and mineral iodine. The results of our earlier analyses on ^{129}I and ^{127}I in thyroids of grazing animals have been reported in a manuscript which is to appear in Health Physics. The results of recent analyses on ^{129}I in two iodine-rich minerals, iodyrite (AgI) and marshite (CuI), establish limits on the initial isotopic composition of iodine, 1.5×10^{-14} less than or equal to $^{129}I/^{127}I$ less than or equal to 1.0×10^{-13}, present when the minerals formed. These results have been reported in a manuscript submitted to the Journal of Inorganic and Nuclear Chemistry. Our 100 additional analyses have been made on ^{129}I and ^{127}I in various types of mammalian thyroid glands from this area, in milk, precipitation, and surface water, and in interlaboratory monitors. A program has been established for systematic sampling of ^{129}I in milk, surface waters, and precipitation. This program will permit us to look for evidence of the spring fallout peak and thus provide information on the stratospheric contribution of ^{129}I to this area.

29120 (INIS-mf-1974) MONITORING OF RADIOACTIVITY IN 1973. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). [nd]. vp. (In French). INIS.

Distributed par CEA Centre d'Etudes Nucleaires, Dept. de Protection, 92260 Fontenay-aux-Roses (France).

Data are presented on the monitoring of radioactive contamination of air and some foodstuffs at world (locations throughout Western South America, South Pacific, Africa during 1973. Data are included on the total β and γ activity and content of radionuclides found in fallout in air, milk and other environmental samples (^{131}I, ^{90}Sr, ^{137}Cs).

29121 (SCPRI-RM-7-1975) MONTHLY PROGRESS REPORT. (Service Central de Protection contre les Rayonnements Ionisants, 78 – Le Vesinet (France)). Jul 1975. 11p. (In French). INIS.

This monthly report of the SCPRI exposes an interpretation of the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{104}Rh, ^{226}Ra, ^{54}Mn, U and T). A monthly bibliographic selection is also presented. (FR)

29122 (SCPRI-RM-7-1975(App.)) APPENDIX TO THE MONTHLY PROGRESS REPORT. Details of the Results of Measurements. (Service Central de Protection contre les Rayonnements Ionisants, 78 – Le Vesinet (France)). Jul 1975. 21p. (In French). INIS.

Measurement tables concerning the surveillance of the environment are presented. (See also the SCPRI-RM-7-1975 report). (FR)

29123 (STI/PUB-404) COMBINED EFFECTS OF RADIOACTIVE, CHEMICAL, AND THERMAL RELEASES TO THE ENVIRONMENT. Proceedings Series. Proceedings of a Symposium Held in Stockholm, 2–5 June 1975. (International Atomic Energy Agency, Vienna (Austria)). 1975. 358p. (In Several Languages). (CONF-7506117–). IAEA $21.00.

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975).

Separate abstracts were prepared for the 22 papers presented at the conference. (HLW)

For abstracts of individual papers see: 29100–29104, 29124–29129, 29165–29168, 29175, 29704, 29767, and 29792–29795.

29124 SYNERGISTIC EFFECTS OF ATMOSPHERIC RELEASES OF RADIOACTIVE GASES AND SO_2 IN INDUCING NUCLEATION IN THE ATMOSPHERE. Vohra, K. G. (Bhabha Atomic Research Centre, Bombay). pp 209-221 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117–.

The paper deals with a study related to the combined effects of SO_2 and ionizing radiations in the formation of condensation nuclei in the atmosphere. Estimates of β dose rate in the air for normal releases of ^{41}Ar, short-lived noble gases and tritium from reactor stacks, and releases of SO_2 from fossil-fuelled power plants are presented. Experimental studies carried out include spontaneous formation of condensation nuclei in the filtered air and correlation of the formation rate with ambient levels of SO_2, radon and ^{41}Ar. It has been shown that the combined effect of SO_2 and ionizing radiations can give a larger production of condensation nuclei than normal photo-oxidation of SO_2 in sunlight. Mechanisms of nucleus formation and possible atmospheric effects of increasing the background concentration of condensation nuclei have been discussed in relation to their role in inadvertent modification of local and global climate. The need for extensive basic research and field studies to establish control measures for any possible climatic impact of future large-scale use of nuclear power has been emphasized. (auth)

29125 ADVANTAGES OF NUMERICAL ATMOSPHERIC DISPERSION CALCULATIONS FOR ESTIMATING DISPERSAL AND COMBINATION EFFECTS OF STACK RELEASES FROM THE NUCLEAR INDUSTRY. Schultz, H.; Voelz, E.; Wueneke, C. D. (Technische Universitaet, Hanover). pp 223-232 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117–.

An estimation of environmental pollution calculated using the idealized Gaussian distribution model to describe processes of atmospheric diffusion suffers from restrictions in the model, i.e., it assumes stationary homogeneous conditions in the atmosphere, a parallel mean wind flow with no (or at most linear) velocity shear, and constant turbulence characteristics within the plume. These assumptions are oversimplifications: for instance topographic effects, wind shear, time-dependent wind variations and the case of strong local interactions of the pollutant with other components in the atmosphere (e.g. fog, smog, rain, or other pollutant plumes) are ignored. Previous attempts to overcome the disadvantages using a purely numerical evaluation of the differential equations describing the transport, diffusion and any reactions of the pollutants in the atmosphere were unsuccessful, since "artificial diffusion" effects were observed that led to unacceptable errors when great distances or long times were considered. At present, the best method of solving this problem appears to be the use of a combined Eulerian-Lagrangian numerical approach, called the particle-in-cell method, which was developed in the USA. The method has been tested successfully by making comparisons with typical Gaussian calculations over long time intervals or large distances: it was also applied to several actual transport problems involving complex topographies with wind variations in time, and to the effects of chemical reactions and local rainfall. This method, avoiding the undue simplification of the Gaussian calculations and the inherent fictitious diffusion patterns of the purely numerical evaluation seems to be particularly suited to solving atmospheric pollution transport problems under complex conditions that may occur in the neighborhood of large nuclear power stations. (auth)

29126 DISCUSSION OF POSSIBLE EFFECTS DUE TO MIXING OF RADIOACTIVE AND THERMAL RELEASES TO THE ATMOSPHERE FROM NUCLEAR POWER PLANTS. Huebschmann, W. G.; Nester, K.; Wilhelm, J. G. (Kernforschungszentrum, Karlsruhe, Ger.). pp 233-242 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, Chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117–.

As the number of reactors, stacks and cooling towers at a power plant site increases, mixing of dry radioactive off-gas with a moist cooling tower plume will occur often enough to require study. For the purposes of this paper, it is assumed that a 100 m high stack of a 1000 MW(e) nuclear power plant lines up with a wet cooling tower in the main wind direction. The mechanism of mixing at various wind velocities is discussed. As compared with the dry off-gas plume, two additional mechanisms influencing the radiological effect of the released activity come into play: the activity concentration near the ground is reduced by the strong buoyancy of the moist plume, whereas the wash-out of aerosols by natural precipitation is increased. The radiological effect of noble fission gas release is reduced, but in the case of radioiodine the two effects partly compensate each other. Future reactors intended for large nuclear power plant sites, therefore, should be equipped with an effective iodine retention system. If this is provided, the mixing of the dry and moist plumes helps to decrease further any radiological impact of nuclear power plants to an almost negligible level. (auth)

29127 SYNERGISTIC EFFECTS OF AIRBORNE EMISSIONS FROM NUCLEAR POWER PLANTS. Fuchs, H.; Hofmann, W.; von Euw, H. M. (Motor-Columbus Consulting Engineers Inc., Baden, Switzerland). pp 243-252 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117–.

The surroundings of a nuclear power plant may be influenced by the way emissions from off-site or on-site sources interact with natural or artificial (cooling-tower) humidity and precipitation. A survey of possible synergistic mechanisms is given. The behavior of SO_2 and iodine is reviewed and aerodynamic effects of the cooling tower on the dispersion of the stack effluents are discussed. Cooling towers may act as turbulence promoters and increase ground-level concentrations of stack emissions, bringing maxima nearer to the source. Measures to reduce this effect are discussed. (auth)

29128 COST EFFECTIVENESS OF RELEASE PREVENTION CONTROLS FOR TRITIUM AND KRYPTON-85. Cohen, J. J. (International Atomic Energy Agency, Vienna). pp 285-298 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117–.

This paper reviews the consequences of releases of tritium and krypton-85 to the environment. The objective is to place these consequences in perspective so that costs for release prevention may be made commensurate with the potential hazard. Evidence is presented indicating that projected levels of krypton-85 may pose a more serious health problem than those of tritium while significantly more past effort has been devoted to tritium control. It is suggested that application of cost/benefit analysis might result in a more efficient allocation of priorities. (auth)

29129 EFFECT OF TEMPERATURE ON THE BEHAVIOR OF MARINE FISHES: A COMPARISON AMONG ATLANTIC MACKEREL, SCOMBER SCOMBRUS, BLUEFISH, POMATOMUS SALTATRIX, AND TAUTOG, TAUTOGA ONITIS. Olla, B. L.; Studholme, A. L.; Bejda, A. J.; Samet, C.; Martin, A. D. (Sandy Hook Lab., Highlands, NJ). pp 299-308 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

A comparison was made of the behavioral responses to temperature of Atlantic mackerel, Scomber scombrus, bluefish, Pomatomus saltatrix, and tautog, Tautoga onitis, held under controlled laboratory conditions. When the temperature was either raised or lowered from normal levels, juvenile and adult bluefish and adult Atlantic mackerel, all pelagic species, responded similarly by increasing swimming speed as much as 61-190%. This response was interpreted as a manifestation of behavioral avoidance of a particular level of temperature, indicative of capability for directive movements relative to ambient thermal conditions. Comparing the response of pelagic species to earlier work on tautog, a demersal species, it was clear that avoidance capability is dependent upon the behavioral repertoire of the individual species. The significance of the results, regarding distribution of fish and response potential under thermal stress, is discussed. (auth)

29130 TWO-DIMENSIONAL TRANSPORT MODEL OF THE ATMOSPHERE. Louis, J. F. Boulder, CO; Univ. of Colorado (1974). 165p. University Microfilms Order No. 75-13,442.

Thesis (Ph. D.).

A two-dimensional transport model of the atmosphere from 0 to 50 km is developed. The transport includes advection by the mean meridional circulation and the diffusion by the large scale eddies. The mean winds and the diffusion coefficients (components of a second order diffusion tensor) vary with latitude, height and season. The contributions of the mean circulation and the diffusion to the transport of tracers are equally important. In many cases they oppose each other. Observed mean winds are used below fifteen kilometers. Above this level the mean winds are computed by solving the thermodynamic and continuity equations. Use is made of the observed distribution of ozone and of its observed vertical flux at the ground to deduce the diffusion coefficients consistent with the mean circulation. The model is capable of simulating the transport of tracers with both low and high latitude sources. It has been tested by simulating the behavior of Tungsten-185 from low latitude United States nuclear tests, and Zirconium-95 from high latitude Chinese nuclear tests. The overall distribution of the tracers, their rate of spreading, the rate of decrease of the maximum concentration, the residence time of the stratospheric burden and the deposition by wet fallout are all well simulated and agree qualitatively and quantitatively with observations. In order to obtain quantitative agreement with observations, the mean winds and diffusion coefficients had to be decreased by a factor of two. The implications of this reduction are discussed. This work demonstrates that a first order closure using a diffusion coefficient tensor (K theory) approximates well the effect of the eddies. It also shows that the diffusion cannot be treated independently of the mean circulation. As an example of the use of the model, the distributions of nitrous and nitric oxides are computed in the stratosphere.

29131 COMMENT ON "THE RELATIVE CONCENTRATIONS OF RADON DAUGHTER PRODUCTS IN SURFACE AIR AND THE SIGNIFICANCE OF THEIR RATIOS" BY C. RANGARAJAN, S. GOPALAKRISHNAN, V. R. CHANDRASEKARAN, AND C. D. EAPEN. Marenco, A.; Fontan, J. (Paul Sabatier Univ., Toulouse). J. Geophys. Res.; 80: No. 36, 5119-5120(20 Dec 1975).

Measurement of the ratio beweeen the short-lived radon daughters and ^{210}Pb in order to determine the aerosol residence time in the troposphere is discussed. It is concluded that the various residence time values obtained experimentally with radioactive elements make it possible to determine parameters representing the processes of vertical exchanges and of scavenging which prevail on a large scale in the troposphere, thus making it possible to use numerical models of simulation for calculating the tropospheric residence time of any other element. (HLW)

29132 RADIOLOGICAL ASPECTS OF ENVIRONMENTAL TRITIUM. Rohwer, P. S.; Wilcox, W. H. Nucl. Saf.; 17: No. 2, 216-223(1976).

The potential radiological implications of tritium released to the environment must be assessed to develop a policy for managing the tritium inventory projected for the nuclear power industry, which already produces tritium in megacurie quantities annually. Development of fusion reactors will create large potential sources for continuous and pulse releases of tritium, much of it as tritium gas. At present 90 percent of the tritium produced is released in gaseous and liquid effluents to be deposited in the hydrosphere as tritiated water. Two alternatives must be considered relative to a long-term policy for tritium management. One method is to dilute and disperse the tritium from power stations and nuclear fuel-reprocessing plants at a rate commensurate with production at the facility, and the second method is to take steps to contain the tritium for storage. A number of factors that influence the magnitude of the estimated radiological impact of tritium on man are discussed, and key points concerning the behavior of tritium along the exposure pathways to man are summarized. (auth)

29133 EFFECT OF NUCLEAR BOMB TESTS AT MURUROA ATOLL ON RADIOACTIVE FALLOUT IN THE SEA AT MAKARA, NEW ZEALAND. Mason, W. J. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). N. Z. J. Sci.; 17: No. 3, 299-307(Sep 1974).

Methods are proposed for measuring the percentage of new fallout entering the sea during the period of a nuclear bomb test by such means as the variation with time of the ratio of two radioactive isotopes of different half-lives. New Zealand fallout figures for cesium-137, strontium-90, prometheum-140, cerium-144, yttrium-91, praseodymium-143, and barium-140, are tabulated from April 1968 to June 1972. Results suggest that some old fallout may be leached back into the sea from material sedimented near beaches. (auth)

29134 ^{210}Pb FLUXES DETERMINED FROM ^{210}Pb AND ^{226}Ra SOIL PROFILES. Moore, H.E.; Poet, S.E. (National Center for Atmospheric Research, Boulder, Colorado 80303). J. Geophys. Res. 81: No. 6, 1056-1058 (20 Feb 1976).

^{210}Pb and ^{226}Ra concentrations versus soil depth profiles are used to determine the ^{210}Pb flux from the atmosphere to the earth's surface. A value of 1.6 dpm cm^{-2} yr^{-1} is obtained. Other methods of obtaining the ^{210}Pb flux are discussed. Values range from 0.53 to 2.0 dpm cm^{-2} yr^{-1} for the north temperate zone. Estimates of continental values range from 0.8 to 2.0 dpm cm^{-2} yr^{-1} and oceanic values from 0.53 to 1.0 dpm cm^{-2} yr^{-1}. (auth)

29135 HIGH SENSITIVITY SAMPLING AND ANALYSIS OF GASEOUS RADWASTE EFFLUENTS. Hearn, R. A.; McFarland, R. C.; McLain, M. E. Jr. (Applied Physical Tech., Atlanta). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 354-356(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The regulatory agencies and federal codes stipulate certain minimum levels of sensitivity for the sampling and analysis of effluents from nuclear facilities. A device for enhancing sample concentration was designed and installed in the gaseous radwaste system of an operating nuclear power plant. A 180-lifer gas sample was compressed into a small calibrated container for gamma spectroscopy. The resulting spectra were analyzed by an on-line programmable calculator with consideration given to offgas system delay times and fission yields for various components in order to accurately establish minimum detection limits. The data from a single sample is correlated with the continuous effluent monitor readings to determine the quantity of radionuclides released for a period of one month.

29136 OFFSITE EMERGENCY RADIATION MEASUREMENT SYSTEMS. Peters, C. W. (Environmental Protection Agency, Washington, DC). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 808-812 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The draft recommendations of a Federal Interagency Task Force on Emergency Instrumentation on the establishment of emergency radiation detection and measurement systems operated offsite by State and local organizations to measure the direct exposure to an airborne release from an incident at a nuclear reactor are reviewed.

29137 ATMOSPHERIC RELEASE ADVISORY CAPABILITY (ARAC). Dickerson, M. H. (Univ. of California, Livermore). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 820-824(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

ARAC is in the initial stages of being implemented and is therefore susceptible to changes before it reaches its final form. However the concept of ARAC is fully developed and was successfully demonstrated during a feasibility study conducted in June 1974, as a joint effort between the Savannah River Laboratory (SRL) and LLL. Additional tests between SRL and LLL are scheduled for December 1975. While our immediate goal is the application of ARAC to assist a limited number of ERDA sites, the system is designed with sufficient flexibility to permit expanding the service to a large number of sites. Success in ARAC application should provide nuclear facilities with a means to handle better the urgent questions concerning the potential accidental hazards from atmospheric releases in addition to providing the sites with a capability to assess the effort of their normal operations.

29138 TECHNOLOGICAL CONSIDERATIONS IN EMERGENCY INSTRUMENT PREPAREDNESS. Selby, J. M. (Pacific Northwest Labs., Richland, WA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 825-826(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Emergency preparedness has been emphasized during the development of the nuclear industry. Existing instrumentation technology has been effectively applied to minimizing the probability of accidents. Radiological instrumentation provided for the measurement of ambient radiation levels or routine releases of radioactive material is usually adequate to provide an early warning that an accident is occurring. In contrast, radiological instrumentation capable of providing a reasonable measure of the source term which could be involved in a severe accident has not received enough attention. In emergency planning the capability should be established for identifying as promptly as possible the need for evasive action out in the plant environs and for minimizing the consequences of an accident in terms of resultant human exposure. Therefore instrumentation is required to measure the source term no matter where the point of release might be, together with instrumentation for obtaining meteorological data sufficient to establish the path of the release in the environment.

29139 AIRBORNE SYSTEMS FOR EMERGENCY RADIOLOGICAL MONITORING. Jupiter, C.; Boyns, P. (EG and G, Inc., Las Vegas, NV). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 813-819(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A variety of aerial radiological monitoring systems are available to respond to a radiological accident or incident affecting large areas. These are operated by EG and G, Inc. for ERDA's Division of Operational Safety. A survey system can be airborne within approximately two hours after notification. Both airborne and terrestrial radioactivity can be measured and mapped. Special analysis procedures allow discrimination between radioactivity from most man-made radioelements and naturally occurring radioelements. A position accuracy of +-54 feet can be maintained over a large area survey. Detection sensitivity for gamma sources employing NaI detector arrays on board an airplane flying at 500 feet altitude is better than 2 mu R/hr for surface planar contaminants and approximately 10 mCi for a point gamma source.

29140 EFFECT OF FALLOUT ON MEASUREMENT OF ^{131}I AROUND NUCLEAR REACTORS. Paperiello, C. J.; Matuszek, J. M. (New York State Department of Health, Albany). Nucl. Technol.; 29: No. 1, 53-56(Apr 1976).

In early July 1974, ^{131}I produced by detonation of a nuclear device by the People's Republic of China appeared in fallout over New York State. Radioiodine levels in milk were measured using a beta-gamma coincidence system with a sensitivity of 0.02 pCi/liter. Peak levels of 1.6 pCi/liter of milk in early July tapered off to approximately 0.1 pCi/liter by early October. When fresh pasture growth ceased and supplemental feed was provided, radioiodine was no longer detectable. This episode shows that operators of light-water power reactors must analyze background samples collected some distance from the reactor site to meet the present U. S. Nuclear Regulatory Commission analytical requirements for ^{131}I as expressed in Appendix I to 10CFR50 and Regulatory Guide 1.42.

29141 SHORT-LIVED FALLOUT RADIOISOTOPES FROM CHINESE AND FRENCH NUCLEAR WEAPON TESTS SINCE 1964. Mishra, U. C.; Lalit, B. Y.; Verma, R. K.; Sadasivan, S. (Bhabha Atomic Research Center, Bombay). J. Sci. Ind. Res.; 33: No. 5, 216-221(1974).

The samples of short-lived isotopes have been collected from commercial aircrafts flying on certain routes and have been analyzed by radiochemical and γ-spectrometric methods. The results for all the Chinese and French nuclear weapon tests conducted since 1964 have been summarized. (Indian Sci. Abstr.)

Soil

Refer also to abstracts 29172, 29279, 29367, and 29369.

29142 DEPTH DISTRIBUTION OF ^{90}Sr IN SOME SOIL TYPES. Csupka, S. (Krajska Hygienicka Stanica, Bratislava (Czechoslovakia)). Jad. Energ.; 21: No. 6, 217-220(Jun 1975). (In Slovak)

The distribution of ^{90}Sr was studied in a 50 cm deep layer of the following types of soils: chernozem, brown soil, sand soil, and calcareous meadow soil. It was found for all types of grass-covered soils that 52 to 58% of the total ^{90}Sr was absorbed in a layer 0 to 5 cm deep, 26 to 35% in a layer 5 to 30 cm deep, and 8 to 22% of ^{90}Sr was absorbed in a layer 30 to 50 cm deep. The distribution of exchangeable ^{90}Sr in proportion to the total content of the radionuclide in the arable and grass-covered soils amounted to 57 to 65% for chernozem, 70 to 73% for the brown soil, 58 to 64% for the sand soil, and 38 to 43% for the calcareous meadow soil. For wooded land it was 84%. (auth)

29143 PROFILES OF LEAD-210 AND RADIUM-226 IN FOUR NEW ZEALAND SOILS. Baltakmens, T. (National Radiation Lab., Christchurch (New Zealand)). N. Z. J. Sci.; 17: No. 4, 435-439(Dec 1974).

The variation of the specific activities of ^{210}Pb and ^{226}Ra with depth below ground surface to a depth of 30 cm has been determined in four New Zealand soils. The concentration of ^{210}Pb in these soils varies between ~0.3 pCi/g and ~0.9 pCi/g; that of ^{226}Ra varies between ~0.4 pCi/g and ~0.9 pCi/g. The concentration of ^{210}Pb shows a maximum near the surface of the soils, owing to accumulation of ^{210}Pb from atmospheric fallout. The results show that that portion of ^{210}Pb which is due to fallout tends to remain within the top 15 cm of the soils, and that this portion constitutes from 18% to 34% of the total ^{210}Pb in this depth. The characteristics of the ^{210}Pb profile are similar for all four soils, and the results obtained from soil analysis are in good agreement with those obtained from ^{210}Pb measurements in rainwater. (auth)

29144 ANALYTICAL APPROACH TO ENVIRONMENTAL RADIATION MEASUREMENTS. Stephens, L. D.; Smith, A. R.; Thomas, R. H. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 719-725(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Environmental radiation measurements have been made at the Lawrence Berkeley Laboratory and the results reported for the past 15 years. These measurements have included both the neutron and gamma contribution to the environment due to laboratory operations. In order to determine these values an understanding of the natural environmental radiation must be known. The techniques for measuring environmental gamma radiation have been improved upon during this time and the latest instrumentation and interpretation methods commonly used at this laboratory are reported. Not only is the natural radiation dose rate important but the isotopes responsible need to be identified for a complete understanding of the observed radiation. The techniques for this determination are described. (auth)

29145 RADIOTRACER STUDIES ON THE MOBILITY AND RETENTION OF MICRONUTRIENTS IN SOIL. Banerji, S. K.; Das, S. K.; Banerji, K. C. (Fertilizer Corp. of India Ltd., Sindri. Planning and Development Div.). Technology (Sindri); 10: No. 3, 175-181(Jul 1973).

The mobility and retention characteristics of five micronutrients, viz. iron, manganese, molybdenum, zinc, and cobalt have been studied and discussed through three different types of soil, viz. Sindri red sandy clay loam, Ranchi clay loam and Amraoti (Maharastra) black loam, using γ-emitting radio tracers, ^{59}Fe, ^{54}Mn, ^{99}Mo, ^{65}Zn, and ^{60}Co. Time dependence of micronutrient mobility and the variation of retention with pH of the soil and nutrient concentration have also been investigated. (auth)

Water

Refer also to abstract 29368.

29146 (EC-SS-48) RADIONUCLIDE LEVELS IN THE GREAT LAKES WATERS, 1973. Durham, M. W. (Department of the Environment, Ottawa, Ontario (Canada)). 1974. 5p. INIS.

The only artificially produced radionuclides detected in the waters of the Great Lakes by γ-ray spectrometry using a large volume Ge(Li) detector were ^{137}Cs and ^{125}Sb. The radioactivity levels of these radionuclides in the open waters of the lakes were measured during the spring and summer of 1973. Similar measurements were made at the plume-lake interface of the Ontario Hydro nuclear generating stations at Douglas Point and Pickering. The results of all the measurements were quite low

with a range of 14 to 87 pCi m^{-3} for ^{137}Cs and 41 to 124 pCi m^{-3} for ^{125}Sb. (auth)

29147 (EUR-5271) STUDIES ON THE RADIOACTIVE CONTAMINATION OF THE SEA. Annual Report 1972. Bernhard, M. (Commission of the European Communities, Luxembourg; Comitato Nazionale per l'Energia Nucleare, La Spezia (Italy). Lab. per lo Studio della Contaminazione Radioattiva del Mare). Dec 1974. 142p. INIS.

The annual report of the CNEN-Euratom Association Contract is presented. The program laid down in this contract calls for the studies of the factors which influence the uptake, accumulation and loss of radioisotopes by different inorganic and organic constituents of the marine environment. The program is divided into two parts: 1) the investigation of relevant radioecological and ecological factors in nature and under laboratory conditions; 2) the investigation of the outfall area off-shore of the CNEN-Trisaia Centre in the Gulf of Taranto (fuel-reprocessing plant). The task of carrying out this program has been divided between six groups: Chemistry, Botany, Zooplankton, Fisheries biology, Microbiology and Special developments. An account is given of the results obtained in 1972. (INIS)

29148 ISOTOPICALLY EXCHANGEABLE PHOSPHORUS IN MAJOR COCONUT GROWING SOILS OF KERALA STATE. Deb, D. L.; Wahid, P. A.; Patel, B. K. (Indian Agricultural Research Inst., New Delhi. Nuclear Research Lab.). J. Indian Soc. Soil Sci.; 22: No. 4, 294-299(Dec 1974).

Isotopically exchangeable phosphorus (E-value) has been determined in 40 randomly selected soil samples covering the major coconut growing areas representing six major soil groups of Kerala State. The tracer technique using P-labelled with ^{32}P was used in the study. Effect of shaking period on surface exchange equilibrium was studied in these soils. It appears that the apparent equilibrium is attained within 4 hours in all the soils. Effect of 1 ppM and 2 ppM carrier levels on E-values was investigated. 2 ppM carrier level was found better than 1 ppM carrier level in most of the soils. Olsen P showed significant negative correlation with E-values at both the carrier levels. (auth)

29149 CYCLE OF RADIONUCLIDES RELEASED INTO WATERS BY THE NUCLEAR INDUSTRY. Bovard, A.; Grauby, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). pp 8.6-1-8.6-4 of Proceedings of the 13. Hydraulics Meeting. Effects of Human Activities of the Hydrometeorological cycle. Paris, September 16-18, 1974. Paris, France; Societe Hydrotechnique de France (1975). (In French).

From 13th hydraulics meeting. Effects of human activities on the hydrometeorological cycle; Paris, France (16 Sep 1974).

A review is made of the main radionuclides released by nuclear industry into the aquatic environment. The water-sediment interactions, the uptake of radionuclides by aquatic organisms and the problem of irrigation water are considered. (FR)

Ecosystems and Food Cycles

29150 (ZAED-BIBL.-02-17) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. Section 02: Contamination and Decontamination of Foods. Number 17. Fischer, E. (comp.). (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Nov 1975. 41p. (In several languages). Dep. NTIS (US Sales Only) $4.00.

References, with indexes, are presented to the world literature during 1973 and 1974 on the contamination of foods with radionuclide and decontamination procedures. (CH)

29151 RADIOACTIVE CONTAMINATION OF POULTRY MEAT WITH ^{60}Co AND ITS ASSESSMENT. Salminen, K.; Obermeier, O. P.; Kreuzer, W. (Univ., Munich). Poult. Sci.; 53: No. 6, 2065-2069(Nov 1974).

The activities of musculature, skin, liver, and kidneys were determined 0.5 to 46 days post peroral 800 nCi./kg. or 400 nCi./kg. $^{60}CoCl_2$ administration in chickens. The activity of the edible parts of the carcasses, musculature plus skin, was estimated to be low due to continuous intake of ^{60}Co at the maximum I.C.R.P. (The International Commission on Radiological Protection) permissible level in drinking water or feed. The elimination of the radio-isotope by restoring the birds to uncontaminated water and feed seems to be impractical due to the slow elimination. A good correlation between the edible parts of the carcasses and liver or kidneys was demonstrated, permitting a reliable method for the assessment of ^{60}Co activity concentration of the edible parts in meat control. (auth)

29152 ANALYSIS OF LITTERFALL IN A DECIDUOUS FOREST ON WALKER BRANCH WATERSHED, TENNESSEE: DATA STRATIFICATION BY TWO ALTERNATIVE METHODS. Grigal, D. F. (Univ. of Minnesota, St. Paul); Grizzard, T. Am. Nat.; 94: No. 2, 361-369(Oct 1975).

Litterfall was monitored for 1 year on Walker Branch Watershed (97.5 ha) in eastern Tennessee. Data were collected from 80 plots, each with a 1 m^2 litter trap, and were stratified in two alternate ways for analysis. In one case, a conventional cover-type map was used to separate the plots into one of four cover types. In the other case, plots were separated into four groups based on multivariate stratification of overstory basal-area data. Subtle differences among strata in seasonal dynamics, total annual quantity, and elemental concentration of litterfall were detected better under the multivariate stratification than under the cover-type stratification. This study demonstrates that analysis of the structure of an ecosystem using multivariate techniques provides a firm basis for subsequent analysis of functions within that system. (auth)

29153 STRONTIUM-90 AND CAESIUM-137 AS DANGEROUS COMPONENTS OF RADIOACTIVE CONTAMINATION IN THE FEEDING CHAIN (SOIL × PLANT × ANIMAL × MAN). Smierzchalska, K. (Polska Akademia Nauk, Jastrzebiec. Instytut Genetyki i Hodowli Zwierzat). Postepy Nauk Roln.; 24: No. 5, 91-107(1972). (In Polish)

Strontium-90 and caesium-137 are presented as dangerous components of the fallout. Their part in radiation contamination in the feeding chain (soil × plant × animal × man) is evaluated. The possible hazard for human population is considered. The levels of contamination of many food products are given. (SB)

Radiometric Techniques

Refer also to abstracts 28545, 29208, 29393, 29395-29398, and 29414.

29154 NONPREVALENCE OF BIOCHEMICAL FOSSILS IN KEROGEN FROM PRE-PHANEROZOIC SEDIMENTS. Leventhal, J.; Suess, S. E.; Cloud, P. (Univ. of California, Santa Barbara). Proc. Natl. Acad. Sci. U.S.A.; 72: No. 12, 4706-4710(Dec 1975).

Evidence of biochemical and geochemical evolution was sought in insoluble carbonaceous matter from 30 selected pre-Phanerozoic sediments ranging in age from about 3.8 to about 0.7 x 10^9 years. The carbon isotope ratios observed were in the range of -20 to -32 per mil with reference to the Peedee belemnite standard, similar to those previously reported. No systematic trends are obvious to us. Stepwise pyrolysis-gas-chromatography showed only molecules with fewer than 8 carbon atoms at the level of sensitivity of 10^{-9} g of organics in a 10 mg rock sample. Carbon, hydrogen, and nitrogen analyses showed noncarbonate carbon from less than 0.1 percent to more than 3 percent, with very small amounts of N. The H/C (atomic) ratios on HCl-leached and HF-treated samples were generally less than 0.3. Evidence of low pyrolysis yields (micro-analysis) and low H/C atomic ratios (macro-analysis) implies that the carbonaceous solids in even the least metamorphosed of these ancient sediments have evolved far toward amorphous carbon or graphite and do not yield useful "biochemical fossils." (auth)

29155 ISOTOPIC STUDY OF HAIL. Jouzel, J.; Merlivat, L.; Roth, E. (CEN de Saclay, Gif-sur-Yvette, France). J. Geophys. Res.; 80: No. 36, 5015-5030(20 Dec 1975).

The article presents a detailed interpretation and discussion of the deuterium and tritium measurements carried out on six hailstones. The isotopic variations of condensed water in a hail cloud are studied on the basis of a cloud model proposed by A. J. Chisholm. The influence of the existence of a liquid water accumulation zone and of the presence of hailstones on isotopic profiles is also analyzed. The importance of tritium analysis is demonstrated, and conditions of validity of the isotopic model proposed by L. Merlivat, G. Nief, and E. Roth in the case of deuterium are defined. The interpretation and discussion of the experimental results are based mainly on the measurements made on three hailstones produced during a storm on August 7, 1971, in the province of Alberta in Canada. It is demonstrated that the hailstones were formed during a succession of upward and downward movements, at least two of the latter occurring in the updraft core, and that the distribution of the updraft velocity with altitude was not stable during the storm, a finding which is in agreement with its multicellular nature.

29156 APPLICATION OF RADIONUCLIDES IN GEOLOGY, HYDROLOGY, AND METEOROLOGY. Akerman, K. pp 264-338 of Radiotracer Method in Practical Work. Bratislava; ALFA (Dec 1972). (In Slovak)

Pages 7-367-translation of "Techniczne zastosowanie metody atomow znaczonych," Warsaw, 1970.

The applications of radiotracers are described in geology for crude oil and natural gas exploitation, in hydrogeology, hydrology, water conservancy, and in meteorology. (INIS)

29157 ORIGIN OF THE PENINSULAR GRANITES. Divakara Rao, V. (National Geophysical Research Inst., Hyderabad (India)). Geophys. Res. Bull.; 12: No. 2, 83-89(Apr 1974).

Major, minor, trace, and radioactive elemental analyses on Closepet, Chitaldurg, Hosdurga and Shimoga granites of Mysore, expressed in terms of their average elemental concentrations and ratios like SiO_2/MgO, Fe_2O_3/FeO, K/Rb and Th/U indicate the following. (1) The Closepet granite had a two-stage history-palingenesis and metasomatism involving enrichment of K, Si, Na, Th, U, Rb, and Cs. (2) The Chitaldurg granite is almost similar to the Closepet granite in chemistry except that it shows intrusive relationship to the country rock. (3) The Hosdurga granite is enriched only in silica but the enrichment of K and depletion of basic elements are not complete thus giving the granite a gneissic texture. (4) The Shimoga granite shows little enrichment in Si and other elements can be called a granitic gneiss. A comparative study of these granites with other granites in Peninsular shield indicate that many of the precambrian peninsular granites are of metasomatic origin and have been enriched at one stage or the other in some of the elements though they show intrusive relationship to the country rock due to palingenesis. (auth)

29158 Rb-Sr AGE DETERMINATIONS FOR THE MOUNT ABU GRANITE AND RELATED ROCKS OF GUJARAT. Crawford, A. R. (Australian National Univ., Canberra. Research School of Earth Sciences). J. Geol. Soc. India; 16: No. 1, 20-28(1975).

The mount Abu Granite of south-western Rajasthan and related "Erinpura type" granites in Gujarat give Rb-Sr total rock ages of about 735 m. y. They are therefore of the same age as the Malani Igneous Suite of western and south-western Rajasthan and not older as previously believed. Though possibly updated by reheating related to emplacement of that Suite, it seems more probable that the two were emplaced at about the same time. This could have taken place in a tectonic environment created by sinistral shear of what are now northern and southern Peninsula India along the Narmada-Son lineament, with bending of the southern end of a rectilinear Aravalli orogenic belt by major fault drag. (auth)

29159 ISOTOPE RELATIONSHIPS OF SULPHUR AND CARBON IN SULPHUR ORE AND IN ITS ACCOMPANYING FORMATIONS VERSUS THE ORIGIN OF SULPHUR DEPOSITS IN POLAND. Czerminski, J.; Osmolski, T. (Instytut Geologiczny, Warsaw (Poland)). Kwart. Geol.; 18: No. 2, 334-357(1974). (In Polish)

The sampling comprised samples of native S, dust S, compact (waxy) S and crystalline S. Samples were taken of various types of S carbonate ores, limestones that accompany the sulphur deposits, and sulfate minerals found in the S deposits. The results of the research on the relationships of S and C in the carbonate deposits are shown in tables and diagrams. According to the degree of S and gypsum crystallization, and to the chemical combination of sulfates the differentiation in isotope composition can easily be seen. However, the crystallization processes are not directly responsible for the partition of the S isotopes. The differentiated relationships of isotopes in S depend upon the solution and crystallization processes, in the course of which the successive phases reveal lighter and lighter isotope that can easily be removed by solutions. (auth)

29160 FISSION TRACK DATING. Nandi, K.; Ray Barman, T. (Geological Survey of India, Calcutta. Geochronology and Isotope Geology Div.). Geol. Surv. India, News.; 5: No. 9, 2-6 (Nov 1974)

After explaining the principle of fission track dating, sample preparation for dating, etching, track recognition and counting, age determination of the material and also age estimation by annealing of the thermal event affecting the age determination of the material are discussed. Other applications of this method are: (i) identification of solid solution series (ii) estimation of uranium concentration in ppM levels and (iii) studies in tectonics. Various problems of Indian geochronology solved by this method are mentioned. (MGB)

29161 USE OF ARTIFICIAL TRACERS IN INDIAN GEOHYDROLOGY AND FUTURE PROSPECTS. Bardhan, M. (Council of Scientific and Industrial Research, New Delhi (India). IHP Unit). Int. Hydrol. Decade Newsl.; 22: 13-24(Oct 1973).

An account of the application of artificial tracers to the solution of geohydrological problems in India during the decade 1963–72 is given. Tracers most commonly employed have been bromine-82, iodine-131, chromium-51, rubidium-86 and tritium. Both single-well point dilution and multiwell tracer techniques have been used. Most of the investigations have been carried out in connection with river valley projects—their development and maintenance. Other investigations relate to the canal seepage, seepage into tunnel, water logging and ground water development problems. The two main organizations active in this field of research in India are: (1) The Central Water and Power Research Station, Poona and (2) The Bhabha Atomic Research Centre, Bombay. A list of 13 major applications of artificial tracers in geohydrological field in India is appended. Potential areas in the field of geohydrology for further applications of artificial tracers in India are also indicated. (INIS)

29162 RADIOMETRIC DATING OF A LITHIUM PEGMATITE NEAR AJMER. Babu, S. K. (Univ. of Saugar, India). Curr. Sci. (India); 45: No. 7, 259-260(5 Apr 1976).

The paper pertains to the determination of geological age of the pegmatites occurring at the village Rajagarh near Ajmer. The determinations are done on lithium minerals namely (Rubellite and Lepidolite), by an uncorrected total Sr method, using Atomic absorption Spectrometer and Neutron activation analysis). The ages determined are in close agreement with the ages given by Vinogradova (1966) and Craford (1970) by the methods of potassium-argon and Rb/Sr, using Mass Spectrometer. (auth)

Site Surveys

Refer also to abstract 32585.

29163 (HW-38707) APPLICABILITY OF GEOPHYSICAL METHODS OF EXPLORATION AT HANFORD ATOMIC PRODUCTS OPERATION. Raymond, J. R. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). Aug 1955. 14p. Dep. NTIS $3.50.

The applicability of electrical, gravitational, magnetic, seismic, and radiometric logging methods to the determination of the geological conditions at Hanford are evaluated for definition or delimitation of the sadalt bedrock surface, the surface of the Ringold formation, and the ground water table. The induction equipment, gravimeter, dip needle, magnetometer, and seismographs can be used to obtain bedrock information. The seismic techniques are the only geophysical methods by which the ground water table depth and thickness of the aquifer can be obtained at this site. (JSR)

Thermal Effluents

Refer also to abstracts 29100, 29101, 29123, 29126, 29704, 29795, and 32401.

29164 (CONF-741033–, pp 75-80) GAS BUBBLE DISEASE MORTALITY OF ATLANTIC MENHADEN, BREVOORTIA TYRANNUS, AT A COASTAL NUCLEAR POWER PLANT. Marcello, R. A. Jr. (Boston Edison Co.); Fairbanks, R. B. 1976.

From workshop on gas bubble disease; Richland, Washington, USA (8 Oct 1974).

In gas bubble disease. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

A substantial mortality of Atlantic menhaden, Brevoortia tyrannus, occurred in the discharge channel and discharge plume area of the Boston Edison Company's Pilgrim Nuclear Power Station Unit 1 during the period April 8 through April 24, 1973. Gas bubble disease was implicated as the cause of their death. Measurements of dissolved gas concentration of the station's intake and discharge water during this fish mortality are presented. Observations on the behavior and results of the pathological examination of menhaden afflicted with gas embolism are discussed. (auth)

29165 SWEDISH STUDIES ON COMBINATION EFFECTS OF THERMAL DISCHARGES IN THE AQUATIC ENVIRONMENT: SOME ASPECTS OF POWER PLANT SITING POLICY. Grimas, U. (Swedish Environment Protection Board, Stockholm); Ehlin, U. pp 69-81 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB–404; CONF-7506117–.

The design of new transport mechanisms by a direct use of the energy of cooling water discharges—heat and kinetic energy—is discussed. An improvement of water quality can be expected in those waters that are overloaded by organic matter for long periods of time. The technique of speeding up the mineralization of organic matter by addition of heat and oxygen requires a detailed

analysis of, amongst other factors, the existing hydrological situation and the concentration levels of toxic matter in the basins affected by the drawing-off and discharge of cooling water. Three situations are identified where the combination of heat and pollution appear to produce negative effects. (auth)

29166 EVALUATION OF THE THERMAL EFFECTS OF A NUCLEAR POWER PLANT. Ioannilli, E.; Smedile, E. (Ente Nazionale per l'Energia Elettrica, Rome). pp 83-94 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

The approach used by ENEL to deal with problems related to the prediction and assessment of the impact upon the environment of the Caorso Nuclear Power Plant is presented. The predictive studies include consideration of the effects of the intake structures, entrainment through the condensers, the thermal plume and chemical discharges. The environmental control consists of a very detailed assessment of the biological resources and chemical parameters in the pre-operational phase, to be compared statistically with a new assessment during operation. (auth)

29167 EFFECT OF ENTRAINMENT IN POWER STATION COOLING SYSTEMS STUDIED USING PERIPHYTIC COMMUNITIES. Smedile, E. (Ente Nazionale per l'Energia Elettrica, Rome); Parisi, V. pp 127-142 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

In the content of ecological research on the impact of power stations on the aquatic environment this paper describes evaluations of such impacts on suspended organisms entering the plant cooling system entrained in the cooling water. A particular dynamic study of entrainment is the comparison of the ability of suspended organisms sampled in the river water ahead of the plant and in the discharge canal to colonize immersed substrates. The dynamics of colonization has been examined in aquaria in which water was circulated that had come either from the intake or from the outfall of La Casella Power Plant. The numbers of systematic groups, their corresponding biomasses and the dimensional structure of animal and plant populations were determined. The data collected show how a temperature rise modifies the characteristics of a periphytic community and the dynamics of colonization of immersed substrata. (auth)

29168 SITE STUDY OF THE MULTIPLE EFFECTS OF THERMAL RELEASES ON THE AQUATIC LIFE IN AN ESTUARINE AREA. Borgese, D.; Dinelli, G.; Guzzi, L.; Smedile, E. (Ente Nazionale per l'Energia Elettrica, Milan). pp 269-284 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

The estuarine area of a river represents a typical site where different factors have to be considered when trying to assess the actual impact on the aquatic life of industrial thermal releases. These factors may be physical (river flow, sea currents, tides, residence time of waters in marshes and lagoons), biological (biomass production, mutual organic matter exchange between fresh and seawaters) and economic such as the commercial importance of fishing. In this respect the siting of a large power station in the Po river delta may cause serous problems for the conservation of the existing ecosystem. Thus a multidisciplinary approach with a view to predicting the final thermal impact of a power station on the environment seems fully justified despite its complexity. Therefore a detailed research program has been established in order to study the following main points: structure of the plant and animal populations; primary production and bacterial activity; physical and chemical characteristics of estuarine waters; coastal characterization; thermal effects on the biocenosis entering the condenser of existing plants operating under similar conditions. Together with conventional experimental techniques, airborne infra-red (IR) and multispectra (MS) surveys are planned as, according to preliminary investigations, they provide essential information for the recognition of water flow patterns and aquatic plant growth. The behavior of the particular ecosystem will be simulated using mathematical models defined on a system theory approach, where the descriptive functions and rate constants come from experimental studies conducted in situ and with laboratory tests. In fact results of preliminary airborne scanning IR and MS surveys combined with biological studies confirm the need for systematic research on the Po river delta. (auth)

29169 EMERGENCE OF INSECTS FROM A BRITISH RIVER, WARMED BY POWER STATION COOLING-WATER. II. The Emergence Patterns of Some Species of Ephemeropta, Trichoptera and Megaloptera in Relation to Water Temperature and River Flow, Upstream and Downstream of the Cooling-Water Outfalls. Langford, T. E. (CERL Freshwater Biology Unit, Nottingham, Eng.). Hydrobiologia; 47: No. 1, 91-133(1975).

A number of authors have suggested that insects living in rivers, even slightly heated by power station cooling water, may have their life-cycles altered sufficiently to lead to the elimination of species owing to early emergence into a lethally cold air, shorter emergence periods, disrupted mating behavior, or the elimination of necessary "chill-periods" in winter. If this were so, an important food resource for fishes in some rivers might be lost. The paper describes in detail the emergence pattern and periods of eight species of Ephemeroptera, seven species of Trichoptera and one species of Megaloptera, upstream and downstream of the outfalls during the period July 1969-November 1971. The patterns are analyzed in relation to river flows and water temperature. It is concluded that before predictions about the effects of power station cooling water discharges on the emergent insects of rivers are made, based on extrapolation of laboratory data, it is essential that the relevant field conditions and relationships should be considered. Also the natural variability and adaptability of species should be investigated in more detail.

29170 COMPARISON OF FOOD HABITS OF WHITE PERCH (MORONE AMERICANA) IN THE HEATED EFFLUENT CANAL OF A STEAM ELECTRIC STATION AND IN AN ADJACENT RIVER SYSTEM. Moore, C. J.; Fuller, S.L.H.; Burton, D. T. (Philadelphia Benedict Estuarine Research Lab., Benedict, MD). Environ. Lett.; 8: No. 4, 315-323(1975).

Analysis of the stomach contents of 97 white perch, Morone americana, taken from the effluent canal of a steam electric station (S.E.S.) and 106 white perch from adjacent Patuxent River waters indicated similar food habits from September 1970 through August 1971. However, 35 percent of all white perch taken from the heated effluent canal contained small pieces of coal and cinders, whereas only 3 percent of the river specimens contained such items in their stomachs. Fly ash and coal dust are present on the bottom of the S.E.S. canal, whereas little such material, if any, can be found on the river bottom in the study area. This suggests the canal fish were actively feeding in the heated effluent and not simply moving into the canal after feeding in the river. No significant difference (P greater than 0.05) was found between the average wet weight stomach contents of the river and canal fish within the same month. (auth)

Chemical Effluents

Refer also to abstracts 28289, 28298, 29100, 29102-29104, 29166, and 29404.

29171 (CONF-741033-) GAS BUBBLE DISEASE. Proceedings of a Workshop Held at Richland, Washington, October 8-9, 1974. Fickeisen, D. H.; Schneider, M. J. (Eds.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1976. 132p. Dep. NTIS $6.00.

Separate abstracts were prepared for 18 papers. All are included in ERDA Energy Research Abstracts and one is included in Nuclear Science Abstracts. (CH)

For an abstract of an individual paper see: 29164.

29172 (ORNL-4928) MATERIAL TRANSPORT THROUGH POROUS MEDIA: A FINITE-ELEMENT GALERKIN MODEL. Duguid, J. O.; Reeves, M. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 201p. Dep. NTIS $8.75.

A two-dimensional transient model for flow of a dissolved constituent through porous media has been developed. Mechanisms for advective transport, hydrodynamic dispersion, chemical absorption, and radioactive decay are included in the mathematical formulation. Implementations of quadrilateral finite elements, bilinear spatial interpolation, and Gaussian elimination are used in the numerical formulation. The programming language FORTRAN IV is used exclusively in the computer implementation. A listing of the program is included. This material-transport model is completely compatible with our moisture-transport model (Reeves and Duguid, 1975) for predicting advective Darcy velocities for porous media which may be partly unsaturated. In addition to a description of the mathematical formulation, the numerical treatment and the computer imple-

mentation results of two computer simulations are included in this document. One is a comparison with a well-known analytical treatment (Lapidus and Amundson, 1952) and is intended as a partial validation. The other simulation, a seepage-pond problem, is a more realistic demonstration of the capabilities of the computer model. Complete listings of input and output are given in the appendices so that this simulation may be used for check-out purposes. A comprehensive description of the material-transport computer model is given.

29173 (PB-240747) EFFECT OF ATMOSPHERIC NUCLEAR EXPLOSIONS ON TOTAL OZONE. Final Report. Bauer E.; Gilmore, F. R. (Institute for Defense Analyses, Arlington, Va. (USA). Science and Technology Div.). Jan 1975. Contract DOT-OS-30057. 42p. (P-1076). NTIS $3.75.

See also PB-239832.

This paper reviews the current empirical knowledge of the depletion of stratospheric ozone due to the injection of oxides of nitrogen from thermonuclear explosions in the atmosphere, discussing both the ground-based observations of global ozone after the 1961-62 multimegaton test series, and also the satellite observations of local effects following an individual French thermonuclear explosion in 1970. There is general agreement on the NO production per megaton (Mt) yield, and on the subsequent ozone depletion expected to be associated with the various nuclear tests. The latter depletion, as calculated principally by Chang and Johnston, extending earlier work of Foley and Ruderman, is small—typically of the order of several percent during a reasonable observation interval—and lies within the probable error of available ozone measurements. Existing atmospheric data do not provide a statistically significant demonstration of the cyclic destruction of ozone by oxides of nitrogen. (GRA)

29174 ON ENVIRONMENT POLLUTION. Graca, M. D. H.; De Andrade, P. V. A. (Fac de Cienc Vet, Nova Lisboa, Angola). Fomento (Lisbon); 12: No. 2, 133-146(1974). (In Portuguese with English abstract).

The authors consider the multiplicity of the causes of the environment pollution. They indicate the action of carbonic gas, carbonic oxide, sulphur gas, phosphates, lead, copper, fluorine, mercury, oil, detergents, pesticides, ionizing radiations, noise, human excreta and stagnant waters. Attention is drawn to the pollution caused by estrogens, several chemical antibiotics, bacteria, viruses, fungi and parasites. (auth)

29175 EFFECT OF THE POLLUTANT BURDEN OF WATER ON THE BEHAVIOR OF RADIONUCLIDES. Bovard, P. (CEA-CEN, Fontenay-aux-Roses, France); Grauby, A.; Saas, A.; Schaeffer, R. pp 179-190 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975). (In French)

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

The authors describe the effect of pollution of waterways on the transfer of radionuclides. Their first example concerns modifications of the chemical equilibrium of iodine as a function of pH-value. Variations in the mobility of several elements under the influence of COD are then studied, and an example of how the mobility potential of a number of radionuclides evolves from the point of release up to the irrigation limit is presented. Finally, interactions between irrigation water and groundwater are dealt with. The work reveals four main types of factors capable of leading to synergic effects: physical factors (pH-value, temperature), chemical factors (saline burden, COD), micro-biological factors (BOD) and extrinsic factors (water regime, utilization). (auth)

29176 RESULTS OF CLINICAL AND HYGIENIC OBSERVATIONS OF WORKING CONDITIONS AND THE STATE OF HEALTH OF WORKERS ON RESEARCH REACTORS. Moiseytsev, P. I.; Denisova, E. A.; Korlyakova, E. A.; Sizikova, N. V. At. Energ. (USSR); No. 2, 90-93(1975). (In Russian)

A report is given on research done for more precise evaluation of the percentage of various components in radiation effects on workers in the vicinity of research reactors and development of radiation safety standards on the engineering design stage in planning new reactors. Installations of type IRT-2000, VVR-S, VVR-K, VVR-M and IBR were studied, as well as critical assemblies. Analysis of radiation monitor data and comparison with the results of dynamic observation of the state of health of personnel showed that working conditions on research reactors are completely satisfactory, and no unfavorable shifts in state of health have been observed among workers. However, studies of this kind should be continued since the time of exposure among this vocational group is still relatively short. (JPRS)

29177 $^{14}C/^{12}C$ RATIOS AS TRACERS OF URBAN POLLUTION. Baxter, M. S. (Glasgow Univ. (UK). Dept. of Chemistry); Harkness, D. D. (Scottish Research Reactor Centre, East Kilbride (UK)). pp 135-140 of Isotope Ratios as Pollutant Source and Behaviour Indicators. Proceedings of the Symposium Jointly Organized by the IAEA and FAO and Held in Vienna, 18-22 November 1974. Vienna; IAEA (1975).

From symposium on isotope ratios as pollutant source and behaviour indicators; Vienna, Austria (18 Nov 1974).

Since fossil carbon is ^{14}C-free environmental materials influenced by industrial activity have $^{14}C/^{12}C$ ratios which are measurably depressed below natural values. In this study $^{14}C/^{12}C$ ratios in samples from an industrial region are compared with those in relatively unpolluted materials. It is shown that artificial sedimentation rates in the coastal sewage dumping area off the West of Scotland are an order of magnitude higher than the natural rate for this region. The $^{14}C/^{12}C$ ratio in the normal industrial atmosphere shows that up to 20% of the total carbon dioxide content is derived from local combustion of fossil fuels. This may be compared with a circa 6% contribution on a world wide basis. (auth)

29178 CONTRIBUTION TO THE STABILITY ASPECT OF METAL ORGANIC COMPLEXES IN SEA WATER. Fukai, R. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 43, 562-570(1974).

Recent studies on the chemistry of various trace elements in sea water have established the occurrence of an organically complexed fraction among the chemical forms present. Little is known, however, about the physico-chemical properties of these complexes. In this paper our present state of knowledge is critically reviewed. On the basis of additional results obtained through experiments using various test reactions, such as decomposition, acidification, ion-exchange, etc., stabilities of the organic complexes, especially of zinc, are considered in detail. The results suggest slow rates of exchange between ionic and organically bound fractions. It was observed that no dissociation of organic complexes of zinc occurred at the pH of seawater at least up to several days after the removal of ionic forms.

29179 MERCURY AS A HYDROSPHERIC POLLUTANT. II. Biological Half-Time of Methyl Mercury in Four Mediterranean Species: a Fish, a Crab, and Two Molluscs. Miettinen, J. K.; Heyraud, M.; Keckes, S. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 39, 1-12(1973).

Analysis of the rate of excretion of methyl mercury introduced by different methods into four marine organisms, Serranus Scriba, Carcinns maenas, Tapes decussatus, and Mytilus galloprivincialis, showed a slow rate of loss, from 267 days in Serranus to 1000 days in Mytilus. The results were compared with those obtained with other crustaceans, molluscs, fish, and a mammal. It was concluded that phylogenetically related species have a similar mode of excretion with a biological half-life that depends on the temperature and method of penetration; the half-life was longer following intramuscular injection than after peroral administration.

29180 PROBLEMS IN INSTRUMENTATION FOR S-ODORANT EMISSIONS. Hall, H. J. (Esso Research and Engineering Co., Linden, NJ). Anal. Instrum.; 12: 1-8(1974).

From 20th annual ISA analysis instrumentation symposium; Pittsburgh, PA, USA (12 May 1974).

Instrumentation to measure sulfur-containing odorants in stack emissions is much more difficult than in the ambient atmosphere, and must be matched to the specific source: key components aside from H_2S are methyl mercaptan in paper mills, COS/CS_2 in a refinery Claus plant, and SO_2/SO_3 in a combustion stack. Satisfactory operation for a period of six months was not achieved by any instrument in this service, in a lab and field evaluation of eight instruments of three types commercially available as of 1971. The effects of interferent gases H_2O, SO_2, CO_2/CO and particulates which are diluted in ambient samples are greatly aggravated in stack gases, where the ratio of odorant to interferent may be 1:1000 or less, due to the very great sensitivity of human receptors to S-odorants. The most serious problem proved to be the analysis for odorless carbonyl sulfide, which is commonly formed where S compounds are oxidized in a reducing atmosphere. This COS has been undetected or mistaken for odorous H_2S in most analyses. A field instrument for the general case would provide exactly simultaneous readings at five minute intervals or less for the five components H_2S, SO_2, COS, CSH, and total S, or their equivalent. This may be simplified to four components or less only when the composition of the sample gas is positively known.

29181 POSSIBLE TRANSFORMATION OF ZINC DISSOLVED IN MEDITERRANEAN COASTAL SEA WATER. Fukai, R.; Huynh-Ngoc, L.; Murray, C. N. (International Atomic Energy Agency,

Monaco). Radioact. Sea; No. 42, 44-45(1974).

Determinations of different chemical forms of zinc in the seawater around Monaco were carried out over a period of 16 months during 1970 to 1971 in order to obtain some understanding of chemical speciation. Zinc-65 was used as a monitor for extraction efficiency. There were increases of zinc in March, July, November, and December of 1970. The major portion appeared to arrive in the form of extractable zinc. (HLW)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 29139.

29182 (AD/A-005564) BIBLIOGRAPHY OF SOVIET MATERIAL ON RADIATION DETECTION, 1972-1974. Kourilo, J. (Informatics, Inc., Rockville, Md. (USA)). 31 Jan 1975. Contract N00600-75-C-0018. 52p. NTIS $4.25.

This is a bibliography of Soviet open-source material on radioactivity detection and measurement techniques, covering the period from 1972 through 1974. Entries are listed alphabetically by author; a source abbreviation list for serial publications is appended. (GRA)

General Detectors and Monitors

Refer also to abstracts 28358, 29051, 29439, 30513, 31047, 31638, and 32468.

29183 (AD/A-005641) PRODUCTION ENGINEERING MEASURE FOR HIGH-RANGE GEIGER-MUELLER TUBE. Quarterly Report No. 6, Sep-Nov 1973. Lehnert, R. W. (LND, Inc., Oceanside, N. Y. (USA)). Dec 1973. Contract DAAB05-72-C-5869. 38p. NTIS $3.75.

See also quarterly rept. No. 4, AD/A-001719.

The purpose of this program is to develop a production method and associated documentation for the high range G-M detector used in the AN/VDR-1 Radiac Equipment. During this reporting period effort has been expended on the following areas: further testing of the third group of engineering test samples; review of all test data; interface with NUCOR and Ft. Monmouth group concerning operation in the AN/VDR-1 equipment; and scanning electron microscope study of treated and untreated cathode surface. The fourth set of engineering test samples were manufactured and are now being tested. (GRA)

29184 (AD/A-007258) PRODUCTION ENGINEERING MEASURE FOR HIGH-RANGE GEIGER-MUELLER TUBE. Quarterly Report No. 7, Dec 1973-Feb 1974. Lehnert, R. W. (LND, Inc., Oceanside, N. Y. (USA)). Feb 1974. Contract DAAB05-72-C-5869. 65p. NTIS $4.25.

See also AD/A-005641.

This program is an investigation of the proper techniques employed to provide stable, predictable performance G-M tubes for use as the high-range detector of the AN/VDR-1. The techniques include special cathode and anode surface treatment to prevent secondary emissions and resultant spurious counts (instability). Four groups of engineering test samples have been manufactured. Testing on the fourth group has been completed during this reporting period. From all indications the tests prove the units to be completely stable and meet all the requirements of the specification. (GRA)

29185 (CEA-CONF-3292) ANALYTIC CALCULATION OF NEUTRON DETECTION EFFICIENCY FOR A HYDROCARBON SCINTILLATOR. Bersillon, O.; Adam, A.; Joly, S. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). 1975. 8p. (In French). INIS.

From 3rd national Soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

An analytic method to calculate the neutron detection efficiency of a scintillator is described. This method takes into account nuclear reactions on carbon which are important above 10 MeV. The results are in good agreement with other data despite some differences around $E_n = 14$ MeV and for $E_n > 20$ MeV.

29186 (CEA-N-1836) MULTISCALER ACQUISITION WITH AUTOMATIC CORRECTION OF RADIOACTIVE DECAY AND BACKGROUND SUBTRACTION FOR THE PLURIMAT SYSTEM. Lefevre, R.; Segalard, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). 2 Oct 1975. 68p. (In French). (CEA-SES-SEG-INT-75-130). INIS.

This paper presents the multiscaler acquisition system, Plurimat, used for on-line measurement of the external radioactivity variations of water in aquarium containing aquatic animals. The role of the parameters to be accessed by the operator during the different tasks is given and the modalities of their introduction is detailed (user-computer dialogue). The execution of the different tasks is described as well as the computation principles of the results typed during acquisition time. Formats of files located on different input-output peripherals connected to the system are given. (FR)

29187 (COM-75-10411) SEMICONDUCTOR NUCLEAR RADIATION DETECTOR STUDIES. Final Report. Sher, A. H. (National Bureau of Standards, Washington, D. C. (USA)). Sep 1974. 11p. (NBSIR-74-626). NTIS $3.25.

Sponsored in part by Atomic Energy Commission, Washington, D. C. See also NBS-Special Pub-400-13 dated Feb 1975, COM-75-10342.

In response to a problem that arose with regard to the availability of germanium for lithium-drifted germanium detectors (Ge(Li) detectors), a comprehensive program was undertaken aimed toward the development of a method for the rapid specification of germanium quality for nuclear radiation detector use, and the determination of factors affecting germanium quality. Measurements on a large number of germanium crystals, most of which had been rejected for detector use, and intercomparison of these measurements and the methods employed, led to significant developments in the measurement of lithium mobility and driftability, carrier trapping, and semiconductor defect and impurity determination via an improved infrared response (IRR) technique. The present improvement of the infrared response technique resulted in the observation of a number of discrete energy levels lying within the forbidden gap of germanium unobserved in previous studies. It was possible to assign the proper position of energy levels detected by IRR in the upper or lower half of the energy gap. It was thus possible, in some instances, to determine the nature of the defects responsible for the observed energy level from results reported in the literature. The goal of developing a method for the rapid specification of germanium quality was achieved. (GRA)

29188 (TRG-Report-2680(S), pp 8-10) SIMPLE STEP SCAN CONTROLLER FOR THE DIFFRACTION ANALYSIS OF β-SiC TEMPERATURE MONITORS. Taylor, T.A.H. (UKAEA Reactor Group, Dounreay). Sep 1975.

From 22nd UKAEA diffraction analysis conference; Dounreay, United Kingdom of Great Britain and Northern Ireland (UK) (15 Oct 1974).

In role of diffraction and electron analysis in the fast reactor programme. (UKAEA Reactor Group, Springfields).

β-SiC is used as a temperature monitor (lattice dilation) in DFR and PFR. This paper describes an automated goniometer controller for the step scanning of highly irradiated β-SiC samples. (DLC)

29189 ANALOGSPANNUNGSBEREICHE UND DIGITALPEGEL FUER NETZBETRIEBENE STRAHLUNGSMESSGERAETE. (Analogue Voltage Ranges and Logic Levels for Mains Operated Nuclear Instruments). Berlin, F. R. Germany; Beuth (Aug 1975). 2p. (In German). (DIN-44800).

3 tabs.

The standard applies to all electronic radiation measurement units, not only to detectors. It relates to the ranges and levels of the signals at the inputs and outputs of the units. It serves the purpose of matching the input and output signals of units working in the analog and the digital modes. The following parameters are fixed: (1) voltage ranges and maximum permissible output voltages for analog signals; (2) output impedances for analog circuits; (3) digital levels and load impedances for binary signals. The standard is identical with IEC publication 323 (1st edition 1970). (DE)

29190 TELESCOPE AND PHOTOMETER "MIZAR". Kuzmin, G.; Kubbar, Malyuto, V. Publ. Tartu. Astrofiz. Obs.; 42: 210-217 (1974). (In Russian).

The 14-inch Cassegrain telescope "Mizar" of W. Struve astrophysical observatory equipped with a photoelectric photometer is described. Both the telescope and the photometer are constructed at the observatory. The telescope is coupled with a standard 8-inch refractor serving as a relatively powerful guiding telescope. Figure 1 gives the scheme of the photometer. It is meant for the UBV-photometry of stars as well as of extended objects (comets, globular clusters). In Appendix the correct optical scheme of the Fabry lens in a Cassegrain telescope is given and discussed. (auth)

29191 ASTRONOMICAL SCANNING SPECTROPHOTOMETER. Ibrus, U. Publ. Tartu. Astrofiz. Obs.; 42: 218-222(1974). (In Russian).

The construction and main characteristics of two Seya-Namioka type scanning spectrophotometers are given. In one scanner for a region from 3000 to 6000Å a grating with 1200 grooves per mm and

a photomultiplier FEU-64, in the other for a region from 5500 to 10,000Å a grating with 300 grooves per mm and a dry-ice-cooled FEU-83 are used. The circular input diaphragms and exit slits give passbands of 20, 50, 80 and 100Å. (auth)

29192 COMPACT ENERGY-CALIBRATED PULSE REFERENCE INPUT ELEMENT. Solov'ev, S. M. Prikl. Yad. Spektrosk.; No. 5, 138-139(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

During tuning of electronic apparatus designed for use with radiation detectors, it is necessary to determine the energy equivalent of noise at the preamplifier input. The design and performance of such a reference element is described. (JSR)

29193 METHOD FOR THE EVALUATION OF THE FORM OF SCINTILLATION PULSES. Trykov, L. A.; Tyufyakov, N. D. Prikl. Yad. Spektrosk.; No. 5, 140-142(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

A method is given for determining the relative value of the fast and slow components of corresponding pulses in cases of the use of a spectrometer tuned for identification of a given radiation by comparison of the total charge of the pulse and its fast component, released on the following diode and anode, respectively, of the photomultiplier. (JSR)

29194 MULTIWIRE GAS-FLOW PROPORTIONAL 4π COUNTER. Kalashnikov, A. M.; Soloshenkov, P. S.; Fedotov, P. I. Prikl. Yad. Spektrosk.; No. 5, 150-152(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The possibility of using a multiwire gas-flow proportional counter for the measurement of the activity of targets and sources with areas of the active spot up to several hundred cm^2 was studied. A pill-box type counter was used in the tests. The measurement of the dependence of the registration efficiency on the area of the active spot showed that satisfactory results could be obtained for active areas up to 360 cm^2. (JSR)

29195 4π COUNTER FOR CALIBRATION OF SOURCES WITH LARGE ACTIVE SPOT AREA. Kalashnikov, A. M.; Soloshenkov, P. S.; Fedotov, P. I. Prikl. Yad. Spektrosk.; No. 5, 153-154(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The spatial characteristics of a gas-flow proportional 4π counter (of the pillbox type) with different diameters of the cathode and anode were studied. The efficiency of the registration of α particles at different points of the counter was studied and the maximum distances from the counter center at which the efficiency stayed constant were evaluated. The anode configuration used made it possible to measure the activity up to a distance of 30 mm. (JSR)

29196 AUTOMATIC INSTALLATION FOR MEASURING ANGULAR $\gamma-\gamma$ CORRELATIONS. Babenko, V. V.; Vishnevskii, I. N.; Latyshev, G. D.; Trishin, V. V. Prikl. Yad. Spektrosk.; No. 5, 183-185(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The characteristics of the automated installation described for measurement of angular $\gamma-\gamma$ correlation using semiconductor Ge(Li) and scintillation detectors is described. A resolving time of fast-slow coincidences in operation with two NaI(Tl) detectors is 3 nsec and for paired Ge(Li) and NaI(Tl) detectors it is 40 nsec for registration of γ radiation of 1.17 to 1.33 MeV from ^{60}Co. The structural circuit of the installation and the automation unit are given. (JSR)

29197 INTEGRAL RADIOISOTOPE SCANNING. Ivanova, Z. M.; Mukhin, V. I.; Fedorov, G. A. Prikl. Yad. Spektrosk.; No. 5, 42-47(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

A method is described for scanning radioactive surfaces in the presence of interferences, such as an extraneous background radiation, which gives more accurate results than traditional methods. It is based on the measurement of the Walsh transforms of the desired distribution functions. (JSR)

29198 SPECTROMETRIC METHOD FOR THE DETERMINATION OF THE LOCATION OF γ EMITTING NUCLIDES IN THE HUMAN ORGANISM. Antonov, V. A.; Konstantinov, I. E.; Moiseev, I. F.; Tikhonov, E. G.; Fedorov, G. A. Prikl. Yad. Spektrosk.; No. 5, 51-57(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The possibility of using the method of statistical regularization, a modified least squares method, and the method of directed divergence for determination of the spatial distribution of γ emitting nuclides in a human was evaluated in a computer comparison of results obtained with each method. The modified least squares method gave the best results. The distributions obtained with the other two methods had a flattened character. The statistical regularization method can be used to solve problems in a wider class of functions than the other two. (JSR)

29199 CHARGED PARTICLE SILICON DETECTORS OBTAINED BY IMPLANTATION OF SODIUM IONS. Korol, V. M.; Zastavnyi, A. V.; Protsenko, A. V. Prikl. Yad. Spektrosk.; No. 5, 74-81(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The conditions used for the preparation of the Na-implanted Si detectors and the experimental verification of their utility for the detection of α particles are described. The critical doses and annealing temperatures were determined and tabulated. The surface resistance was measured as a function of the annealing temperature and time. The volt-ampere and volt-capacitance characteristics were determined. Typical spectra are given. All the tests indicated that the implantation method used was satisfactory for the preparation of semiconductor detectors. (JSR)

29200 CHARACTERISTIC SINGULARITIES OF THE BEHAVIOR OF IONIZATION DEFECTS IN SEMICONDUCTOR DETECTORS AS A FUNCTION OF THE ENERGY OF THE REGISTERED PARTICLE. Kassirov, S. A.; Kovshevnyi, G. G.; Kotov, A. A.; Reznik, V. R.; Sinogeev, I. N.; Solyakin, G. E.; Terent'ev, N. K. Prikl. Yad. Spektrosk.; No. 5, 82-89(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The dependence of the ionization defects on the energy of the registered particle was measured for ions of ^{19}F, ^{27}Al, ^{40}Ca, and ^{58}Ni. An analysis of the results indicates that the mechanism of formation of ionization defects is connected with the appearance of shell effects in the process of the capture of the medium electrons by ions being slowed down. For Si the strongest should be the transition between the L and M shells. (JSR)

29201 DETERMINATION OF THE THICKNESS AND HOMOGENEITY OF THE SENSITIVE REGION OF SEMICONDUCTOR DETECTORS BY MEANS OF FAST MONOENERGETIC NEUTRONS. Kuritsyn, V. N. Prikl. Yad. Spektrosk.; No. 5, 90-93(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

A proton recoil method was used to measure the thickness and homogeneity of the sensitive region of Si semiconductor detectors. The recoil protons were obtained by irradiation of a thick polyethylene target with 14 MeV neutrons. The results showed that the method is valid for determination of the thickness of a sensitive region up to 1500 μ. (JSR)

29202 THICKNESS OF THE SENSITIVE REGION OF P-I-N RADIATION DETECTORS. Azimov, S. A.; Muminov, R. A.; Yafasov, A. Ya. Prikl. Yad. Spektrosk.; No. 5, 94-96(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The validity of a correction coefficient to the formula generally used for the determination of the thickness of the sensitive region in Si(Li) p-i-n detectors was evaluated. The experimental results showed that the correction coefficient does not make experimental and calculated values of the capacitances agree but that the divergence is much less when it is used. (JSR)

29203 EFFECT OF EXTENDED STORAGE ON THE CHARACTERISTICS OF Si(Li) P-I-N DETECTORS. Azimov, S. A.; Muminov, R. A.; Yafasov, A. Ya. Prikl. Yad. Spektrosk.; No. 5, 97-99(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The changes of the volt-ampere, volt-capacitance, and volt-noise characteristics and the energy resolution during a 24-hour period were measured on Si(Li) detectors. The results showed that the characteristics of the original material and the method of preparation had a large effect on the time stability of the detectors. (JSR)

29204 GROOVED WINDOWS FOR SCINTILLATION CRYSTALS AND LIGHT PIPES OF HIGH REFRACTIVE INDEX. Swinehart, C. F. (to Kewanee Oil Co.). US Patent 3,930,160. 30 Dec 1975. Filed Date 11 Feb 1974. 8p.

Scintillation crystals are disclosed which have improved resolution and pulse height. An improved crystal has shallow grooves

or spot depressions cut in the window, usually an end surface. Typical grooves are about 1.5 mm wide and about .1 mm deep. The grooves may be either horizontal, generally parallel grooves in spaced apart relationship, or concentric rings in radially spaced apart relationship. A light pipe of high refractive index, such as a crystal of pure sodium iodide, may also be improved with shallow grooves or spot depressions cut in an end surface. (auth)

29205 . MATRIX-FORM RADIATION IMAGE CONVERTER. Reiss, K. H. (to Siemens Aktiengesellschaft). US Patent 3,930,162. 30 Dec 1975. Priority Date 21 Jun 1972, German, Federal Republic of (F. R. Germany). 6p.

An image converter is used to make visible images produced by gamma rays or similar penetrating rays like X-rays, etc., by transforming the distribution of ray density contained in a bundle of rays carrying the image which is to be made visible, by means of a cathode and an anode spaced from the cathode. The space between the electrodes contains a gas and the electrodes are subjected to a voltage which produces electrical discharges during ray penetration at corresponding locations depending upon the rays. The cathode as well as the anode consists of a plurality of parts having large surfaces which extend at least approximately perpendicularly to the ray incoming surface of the converter, so that the electric field extends parallel to this surface. The invention is particularly characterized in that the gas is under pressure in the range of 10 at., that the applied voltage makes certain the operation in the proportional range and that parts of the anode and of the cathode are combined in rows. Rows of the cathode elements and those of the anode extend at an angle to each other, the rows being connected electrically with a device for forming an electronic intensity center which produces representable local signals for orientation of the discharge bundle striking the anode. (auth)

29206 LIQUID SCINTILLATION, COUNTING, AND COMPOSITIONS. Sena, E. A.; Tolbert, B. M.; Sutula, C. L. (to Sentol Associates). US Patent 3,928,227. 23 Dec 1975. Filed Date 20 Feb 1973. 10p.

The emissions of radioactive isotopes in both aqueous and organic samples can be measured by liquid scintillation counting in micellar systems. The micellar systems are made up of scintillation solvent, scintillation solute and a mixture of surfactants, preferably at least one of which is relatively oil-soluble water-insoluble and another which is relatively water-soluble oil-insoluble. (auth)

29207 THREE DIMENSIONAL RADIOISOTOPE IMAGING USING GAMMA RAY COINCIDENCE SCANNING. Rudin, S. New York; City Univ. of New York (1975). 172p. University Microfilms Order No. 76-1489.

Thesis (Ph. D.).

The field of nuclear medical imaging has generally involved the use of standard low energy gamma ray detection techniques and appropriate collimation and data handling methods to obtain approximate two dimensional projections of the three dimensional radionuclide organ distributions. In order to obtain qualitatively significant improvement in spatial resolution, however, a true tomographic or three dimensional imaging technique will probably have to be developed. One such technique is Focusing Collimator Coincidence Scanning (FCCS). This technique involves the combined use of coincident gamma ray detection and focusing collimators to improve the spatial resolution of radioisotope imaging. The overall purpose of this work was to examine the imaging properties of this particular technique in order to determine whether further development for biological and clinical usage is indicated. (WHK)

29208 MEASUREMENT OF SUBSURFACE FORMATION LITHOLOGY, INCLUDING SHALINESS, USING CAPTURE GAMMA SPECTROSCOPY. Scott, H. D. (to Texaco Inc.). US Patent 3,928,763. 23 Dec 1975. Filed Date 12 Dec 1974. 30p.

Gamma ray spectra of earth formations surrounding an open or cased well borehole are obtained by exciting subsurface formation elements around the borehole with neutrons and detecting the gamma rays resulting from capture in the subsurface formation of thermalized neutrons from a capture gamma spectroscopy (C.G.S.) well log source. The macroscopic thermal neutron capture cross-section of the formations is also known or obtained, either from the C.G.S. log or other previous logs. The spectra of gamma rays obtained from the formation are analyzed to form logs of the elements which contribute significantly to the spectra. From these logs, a partial macroscopic thermal neutron capture cross-section of the elements contributing to the gamma rays of the spectrum is obtained. The partial macroscopic thermal neutron capture cross-section so obtained is then compared with the capture cross-section of the formation to obtain an indication of the shaliness of the formation. (auth)

29209 MEASUREMENT OF THE TIME STABILITY OF INSTRUMENTS BY THE CONSTANT COUNTING RATE TEST. Dvorak, V. Radioisotopy; 16: No. 4, 629-641(1975). (In Czech)

A new method of time stability measurement is described, suitable for radioactive radiation measuring instruments which are provided with an amplitude analyzer or pulse discriminator. The method enables a more precise time stability control of the amplification and of the discrimination level. The measuring conditions may be adjusted so as to minimize the effect of counting rate variations (due to the statistic character of the radioactive decay of the reference radionuclide) with respect to the instrumental error. The time stability measurement method is used for the checking of scintillation detector units, scintillation spectrometers and γ radiometers. (auth)

29210 OSNOVY METROLOGII NEYTRONNOGO IZLUCHENIYA. (Bases of the Metrology of Neutron Radiation). Vasil'ev, R. D. Moscow; Atomizdat (1972). 312p.

This book is an exposition of the scientific bases of the metrology of neutron radiation. It formulates the principles of metrology in neutron measurements in reactors, accelerators, and with isotope sources. Methods of direct and indirect measurements of radiometric quantities and individual methods of combined measurements used for finding spectrometric relationships are generalized. Methods of mutual comparisons of measurements and measuring instruments are systematized. Questions of terminology are considered. (JPRS)

29211 METHODS OF CORRECTING ANGER CAMERA DEADTIME LOSSES. Sorenson, J. A. (Univ. of Utah Medical Center, Salt Lake City). J. Nucl. Med.; 17: No. 2, 137-141(Feb 1976).

Three different methods of correcting for Anger camera deadtime loss were investigated. These included analytic methods (mathematical modeling), the marker-source method, and a new method based on counting "pileup" events appearing in a pulse-height analyzer window positioned above the photopeak of interest. The studies were done with /sup 99m/Tc on a Searle Radiographics camera with a measured deadtime of about 6 mu sec. Analytic methods were found to be unreliable because of unpredictable changes in deadtime with changes in radiation scattering conditions. Both the marker-source method and the pileup-counting method were found to be accurate to within a few percent for true counting rates of up to about 200 K cps, with the pileup-counting method giving better results. This finding applied to sources at depths ranging up to 10 cm of pressed wood. The relative merits of the two methods are discussed.

29212 WHOLE-BODY MONITOR CD-2— PARAMETERS AND APPLICATION IN CLINICAL WORK. Silar, J. (Karlova Universita, Prague (Czechoslovakia). Lekarska Fakulta Hygienicka); Boucek, J. (Karlova Universita, Prague (Czechoslovakia). Fakulta Vseobecneho Lekarstvi). Jad. Energ.; 21: No. 6, 211-217(Jun 1975). (In Czech)

The collimation characteristics are described of a detection system and basic parameters are given of the CD-2 clinical whole-body monitor connected to a TESLA NZG-312 evaluation unit. The monitor was built using Czechoslovak-made parts and permits clinical whole-body examinations of satisfactory statistical accuracy when activities in a range from 1 to the tenths of μCi in the primary radiation energy region between 150 keV and 2 MeV are applied. The detection system of the monitor is designed so as to permit, in addition to whole-body examination, also measurement of high-volume samples and whole-body profile scanning.

29213 REMOVAL OF BACKGROUND IN NUCLEAR PHOTOGRAPHIC EMULSIONS. Zakharov, V. I.; Novikova, N. R.; Perfilov, N. A. Zh. Nauch. Prikl. Fotogr. Kinematogr.; 20: 272-277 (1975). (In Russian).

An oxidation and an adsorption method for removing storage background and irradiation background in nuclear photographic emultions were compared. The oxidation method consists in soaking the photographic films in a solution of potassium ferricyanide, while the adsorption method involves soaking in hydrolyzed gelatin solutions. The methods were compared with respect to the degree of the desensitizing action of the solutions on the films, the magnitude of the maximum removed flux of alpha particles during recording of heavy nuclear fission fragments, and the stability of the results upon changing the magnitude of the flux of background particles and other parameters. Findings showed the adsorption method to be most effective.

29214 SOME PROBLEMS ON THE PHOTOGRAPHIC METHOD OF RECORDING IONIZING RADIATION. Zakharov, V. I.; Novi-

kova, N. R. Zh. Nauch. Prikl. Fotogr. Kinematogr.; 20: 305-313(1975). (In Russian).

The paper reviews selected aspects of the method of photographic recording of nuclear radiation, a method based on photolysis and radiolysis, that is, the decomposition of a silver halide and formation of silver. The properties of nuclear emulsions for recording charged particles in strong magnetic fields are discussed. Means of controlling the dimensions and structure of grains in the tracks of charted particles are examined. Also discussed are the application of monodisperse emulsions and the properties of emulsions with synthetic polymers.

29215 γ-DETECTORS OF THE RADIATION TYPE BASED ON "PURE" GERMANIUM. Eremin, V. K.; Dudnik, E. P.; Levinzon, D. I.; Strokan, N. B.; Tisnek, N. I.; Chikalova, O. P. Sov. At. Energy (Engl. Transl.); 39: No. 1, 638-639(Jul 1975).

Translated from At. Energ.; 39: No. 1, 62-63(Jul 1975).

The recent development of semiconductor radiation detectors has increased the interest in materials with concentrations of uncompensated impurities $|N_D - N_A| \leq 10^{10}$ cm^{-3}. Such small concentrations can be achieved by extremely high purity of the material or by using various compensation methods. The first way was used to obtain germanium with $|N_D - N_A| \approx 10^{10}$ cm^{-3}. Among the compensation methods doping with Li^+ ions and "cold doping" lead to detectors which do not require continuous cooling even in storage. The possibilities of cold doping is described by the example of germanium with $N_D - N_A \approx 10^{11}$ cm^{-3}. (WHK)

29216 INTRODUCTION OF MATHEMATICAL AND INFORMATICS METHODS IN NUCLEAR MEDICINE. Martin, J.; Monot, C.; Legras, B. pp 145-157 of Treatise of Nuclear Medicine. Vol. 1. Theoretical Basis. Meyniel, G.; Berger, J. A.; Chanteur, J.; Cohen, Y.; Di Paola, R.; Ducassou, D.; Gaillard, G.; Isabelle, D.; Lahneche, B.; Martin, J. Paris, France; Flammarion Medecine Sciences (1975). (In French).

Mathematical and statistical methods are widely used in nuclear medicine because of the abundance and precision of the data obtained during morphological and dynamic explorations, and the number and complexity of the calculations involved has led to the use of informatics. Very elaborate techniques may be employed with the help of the computer. In spite of its cost it is closely associated with exploration techniques, especially in conjunction with the scintillation camera. To keep the machine in full-time use and ensure its profitability it is employed in other capacities, for in-service management in particular. Each subject is dealt with from its fundamental aspect: nuclear medicine and biomathematics, statistics, informatics; compartment models in nuclear medicine (interpretation of dynamic examinations); quantitative image processing; special computer services (connections with apparatus, service and records management problems).

29217 SENSITOMETRIC CHARACTERISTICS OF UF-R, UF-VCh, AND UF-VR FILM USED TO RECORD SOFT X RADIATION (λ = 2-10 A). Aglitskii, E. V.; Beiko, V. A.; Kalinkina, T. A.; Oshurkova, A. N.; Pikuz, S. A.; Uvarova, V. M.; Faenov, A. Ya.; Shpol'skii, M. R. (Lebedev Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1265-1267(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 207-209(1975).

The sensitometric characteristics of the following types of photographic film were measured in the range of wavelengths 2-10 Å: UF-R, UF-VCh, and UF-VR. It was demonstrated that UF-VR photographic film is four times as sensitive as UF-R film and 1.6 times as sensitive as UF-VCh film; it is also the most suitable film for x-ray spectroscopy of multiply charged ions and for diagnosing high-temperature laser plasma.

29218 TEMPORAL AND SPECTROMETRIC PARAMETERS OF FEU-85 AND FEU-87 PHOTOMULTIPLIERS. Bondarenko, V. G.; Grigor'ev, V. A.; Maklyaev, E. F.; Runtso, M. F. (Moscow Engineering Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1205-1206(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 160-162(1975).

A light-pulse generator using a type AL102B light-emitting diode has been used to investigate the temporal and spectrometric parameters of the small FÉU-85 and FÉU-87 photomultipliers. It was found that the time resolution of the FÉU-85 and FÉU-87 may be improved by 20-50% through suitable choice of the individual voltage divider. It has been shown that the time and amplitude resolution of the FÉU-85 is inversely proportional to the square root of the number of photoelectrons over a wide range of illumination intensities.

29219 CHARACTERISTICS OF A SPIRAL CHANNEL MULTIPLIER IN THE ULTRASOFT X-RAY AND ULTRAVIOLET REGIONS. Ainbund, M. R.; Zaslavskii, V. Ya. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1230-1232(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 181-183(1975).

The dependence of the amplitude distribution of the output and the input distribution of the relative efficiency of a channel electron multiplier (c.e.m.) on the wavelength of the recorded radiation is revealed. The absolute values of sensitivity and certain other characteristics of c.e.m. are presented.

29220 FLUX OF HIGH-LET COSMIC-RAY PARTICLES IN MANNED SPACE FLIGHT. Benton, E. V. (Univ. of San Francisco); Henke, R. P.; Peterson, D. D.; Bailey, J. V.; Tobias, C. A. pp 121-128 of Life Sciences and Space Research. XIII. Berlin; Akademie-Verlag GmbH (1975).

From proceedings of the seventeenth plenary meeting; Sao Paulo, Brazil (17 Jun 1974).

On the Apollo and Skylab missions the high-energy heavy ion (HZE) flux was measured by means of plastic nuclear track detectors. Measurements involved the fluxes of high linear energy transfer (LET), particles with Z between 6 and 26 incident on astronauts and on several biological experiments. Partial results of these measurements are presented; the effects of shielding and solar modulation are discussed.

29221 USE OF A TIME-AMPLITUDE CONVERTER FOR MEASURING SMALL AMOUNTS OF ACTIVITIES OF ISOTOPES HAVING METASTABLE STATES. Il'ichev, O. V.; Kolobashkin, V. M.; Serbulov, Yu. A.; Ignatov, V. P. (Moscow Engineering-Physics Inst.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 132-134(1975). (In Russian)

The method of delayed beta-gamma coincidences is widely used to count isotopes having metastable states of daughter nuclei. This study describes a modification of this method in which in place of a coincidence circuit and a delay line, use is made of a converter which transforms time intervals to amplitude, and of a pulse amplitude discriminator. By using this arrangement along with an anticoincidence detector and a lead shield 5 cm thick it is possible to lower the background of the unit to 0.5 pulses per minute, and with the use of beta and gamma detectors having a measuring geometry close to 4 π it is possible to obtain highly efficient counting. (SJR)

29222 MUTUAL INTERFERENCE IN MULTIPLEXING EQUIPMENT. Khait, V. Z. (Moscow State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1165(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 128(1975).

When radioactivity signals from several counters are simultaneously recorded through a single pulse-height differential discriminator there is mutual interference between the individual channels. The determination of the noise level is investigated theoretically; the results show that for equipment devised in the laboratory the noise level does not exceed 0.1% of the output flow.

29223 SCINTILLATION CAMERA WITH IMPROVED RESOLUTION. Jaszczak, R. J. (to Searle (G.D.) and Co., Skokie, Ill. (USA)). Canadian Patent 970,481. 1 Jul 1975. 28p.

Available from Commissioner of Patents, Ottawa.

An Anger-type scintillation camera system fitted with a gamma ray filter between the object under study and the detector and a signal funneling type of output signal filter, in mechanical or electrical form, associated with an image recording film is described. The gamma ray filter and signal funneling type of output signal filter scan in synchronism so that the total radioactivity distribution in the object is documented on the film with improved resolution.

29224 QUENCH CORRECTION IN LIQUID SCINTILLATION COUNTING. Kulberg, G. H.; Deinert, R. H. (to Searle (G.D.) and Co., Skokie, Ill. (USA)). Canadian Patent 970,482. 1 Jul 1975. 19p.

Available from Commissioner of Patents, Ottawa.

A means for determining counting efficiency in a liquid scintillation system is described. Pulse amplitudes are accumulated as are the number of pulses contributing thereto. The accumulated pulse amplitude sum is divided by the accumulated number of pulses to produce an average pulse amplitude for the pulses measured. The average pulse amplitude may be correlated to average detection efficiency by an ascertainable function. Through average efficiency of detection the actual rate of radioactive disintegrations may be computed from the count rate measured.

29225 USE OF PHOTOGRAMMETRY FOR TAKING THE OUTLINE OF PATIENTS IN RADIOTHERAPY. Borel, F.; Defer, J.; Aget, H.; Gallet, O.; Urbajtel, M.; Laugier, A. (Hopital Tenon, 75 - Paris (France)). J. Radiol., Electrol., Med. Nucl.; 56: No. 5, 433-437(May 1975). (In French)

A photogrammetric method for taking the outline of patients in radiotherapy is described. Using only one couple of photographs, this fast and very precise process may reconstruct many trans-

versal or longitudinal cross-sections after a photographic storage of information. An automatic numerical reading of the outline may be directly fed into a computer for dosimetry.

29226 SCINTILLATOR CRYSTAL FOR GAMMA-RAY CAMERAS. Chalons, F.; Floyrac, R. (to Agence Nationale de Valorisation de la Recherche (ANVAR), 92 - Paris-Defense (France)). French Patent 2,237,206/A/. 13 Jul 1973. 10p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

The scintillator crystal comprises a large surface turned towards the source transmitting gamma rays impinging thereon, said surface being furrowed with a large number of deep rectilinear slots defining numerous protrusions of prismatic shape with side walls at right angles to said crystals surface. Said scintillator crystal is adopted to detect gamma rays and in particular, gamma rays used in medical gamma-ray cameras.

29227 AMPLIFIER–SHAPER HYBRID INTEGRATED MICROCIRCUIT FOR PROPORTIONAL CHAMBERS. Baru, S. E.; Basiladze, S. G.; Groshev, V. R.; Gusak, M. V.; Markus, M. I.; Onuchin, A. P.; Proviz, G. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1132-1135(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 105-107(1975).

A hybrid "amplifier-shaper" integrated microcircuit has been developed for proportional chambers. The housing is nonmagnetic and its dimensions are 11.6 × 11.6 × 5 mm. The amplifier-shaper may be used jointly with TTL and ECL integrated circuits, and it has an output for amplitude analysis. The sensitivity threshold is 1.1 mV ± 10%, and the input resistance is 1.3 kΩ ± 10%. The time resolution with the proportional chamber filled with Ne + 8% Ar + 20% CO_2 + 3.5% C_2H_5OH gas amounts to $\tau_{\frac{1}{2}}$ = 12 nsec, and the plateau width is 500 V.

29228 HIGH-SPEED COINCIDENCE CIRCUIT HAVING A RESOLUTION OF 1 NSEC. Boreiko, V. F.; Zinov, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1087-1088(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 68-70(1975).

A coincidence circuit is described having a minimal resolution of 1 nsec and a speed of response 100 MHz. In each channel there is an electronic delay which allows smooth variation of the time position of the pulses by 2 nsec.

29229 CALCULATION OF THE EFFECTIVE SOLID ANGLE OF AN EXTENDED RADIATION SOURCE. Khleskov, V. I. (Inst. of Biophysics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1060-1062(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 49-51(1975).

In order to calculate the effective solid angle of an extended circular source with a circular iris, a series is derived which allows the analysis to be restricted to the first two nonzero terms with a computation accuracy of at worst tenths of a percent in the majority of practical cases. Based on the derived formulas the possible errors in the magnitude of the effective solid angle are calculated as functions of the geometric dimensions of the system for random errors of the source diameter and its distance from the iris.

29230 BEHAVIOR OF SURFACE-BARRIER DETECTORS IN AN IONIZED-GAS MEDIUM. Bacho, I.; Kushniruk, V. F.; Pajit, A.; Rykhlyuk, A. V.; Kharitonov, Yu. P. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1052-1055(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 42-45(1975).

The behavior of various surface-barrier detectors which are distinguished by the type of conductivity of the original material and by the fabrication method in an ionized-gas medium was investigated. The results obtained can be explained well on the basis of the assumption that the positive or negative charge on the detector surface is absorbed. The shielding of the edge of the p–n transition preserves the characteristics of the detectors under irradiation. It turned out that detectors made of p-Si have an elevated stability.

29231 SEMICONDUCTOR DETECTORS FOR MEASURING THE ALPHA ACTIVITY OF LIQUIDS. Bychenkov, A. I.; Malafeev, M. P.; Sirotinin, A. N. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1049-1051(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 39-41(1975).

Semiconductor surface-barrier detectors for measuring α activity of electrically conducting liquids are described; the detectors are fabricated from single-crystal p-Si. The sensing surface of the detectors is in direct contact with the measured liquid, and the perimeter of the crystal is made vacuum-tight by welding it into a glass tube. Detectors having a sensing-surface area ranging from 0.25 to 5 cm^2 allow measurement of the α activity of liquids in the $3 \cdot 10^{-9}$–$3 \cdot 10^{-3}$ Ci/cm^3 range.

29232 AUTOMATION OF THE PROCESSING OF TRACKS IN SOLID-STATE TRACK DETECTORS. Pribytov, V. I.; Rozov, B. S. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1007-1013(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 7-12(1975).

Methods for automated determination of the parameters of tracks and solid-state nuclear-particle track detectors are considered, and the existing experimental installations are described. The characteristics of certain instruments are presented.

29233 RELATIVE FULL-ENERGY PEAK DETECTION EFFICIENCY OF Ge(Li) DETECTORS. Chung, W. H. (Korea Merchant Marine Coll., Pusan). J. Korean Nucl. Soc.; 7: No. 3, 223-226(Sep 1975).

The relative detection efficiency of γ-ray full-energy peaks was obtained by a pair-point method using the ^{56}Co source whose γ-ray relative emission rates were well measured. Three Ge(Li) detectors with active volumes of 43.8 cc, 32.6 cc, and 6 cc were calibrated over the γ-ray energy energy range 800 to 3,500 keV.

29234 GROWTH OF FINE HOLES IN POLYETHYLENENAPHTHALATE FILM IRRADIATED BY FISSION FRAGMENTS. Komaki, Y.; Tsujimura, S. (Division of Chemistry, Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken, Japan). J. Appl. Phys. 47: No. 4, 1355-1358 (Apr 1976).

Growth of fine holes by chemical etching in polyethylenenaphthalate films exposed to fission fragments were examined by measuring gas flow through the films. The etching rate along tracks, the radial etching rate, and the bulk etching rate were determined at effective hole diameters of 100–1 000 Å and hole densities of approximately 10^8 cm^{-2}. The effects of ethanol and surfactants on the etching rates were studied from the viewpoint of attaining less-tapered holes. (auth)

29235 COMPARISON OF THE MEASUREMENT OF BEAM-CURRENT DENSITIES IN AN ELECTRON MICROSCOPE USING A FARADAY CUP AND SOLID-STATE DETECTOR. Howitt, D.G.; Thomas, G. (Department of Materials Science and Engineering, College of Engineering, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Toutolmin, W. J. Appl. Phys. 47: No. 4, 1694-1696 (Apr 1976).

A Faraday cup has been constructed which is capable of accurately measuring beam-current densities in the image plane of an electron microscope. This device has been employed to calibrate a solid-state detector typical of those often used to measure such small electron intensities. The ability of the solid-state detector to distinguish single electrons was found to be a sensitive function of the incident electron intensity. Important applications of this work include investigations of radiation damage in beam-sensitive materials, e.g., biological specimens. (auth)

29236 JUNCTION-FET DOSIMETER. Tomimasu, T.; Yamazaki, T. (Electrotechnical Laboratory, Tanashi, Tokyo, Japan). J. Appl. Phys. 47: No. 4, 1732-1734 (Apr 1976).

The performance of a new junction-FET dosimeter and its application to the beam profile measurement are presented. One of the two junction FET's making up an astable multivibrator is used as a small-size (~0.4×0.4 mm) high-level dose detector. The irradiated dose can be estimated by the amount of the decrease of the oscillator period of the multivibrator. The distinct advantages in its small size and superior resistive property to radiation effect enable us to measure the cross-sectional profile of the electron beam from a linac with high spatial resolution of about 0.4 mm. (auth)

29237 TIME RESOLUTION OF Ge AVALANCHE PHOTODIODES OPERATING AS PHOTON COUNTERS IN DELAYED COINCIDENCE. Fichtner, W.; Häcker, W. (Physikalisches Institut der Universität Stuttgart, 7 Stuttgart 80, Germany). Rev. Sci. Instrum. 47: No. 3, 374-377 (Mar 1976).

The application of Ge avalanche photon counters for fast light detection in the energy range $0.7 < h\nu < 1.1$ eV is investigated. Individual photons cause discrete self-sustaining avalanche pulses in alloyed Ge diodes, slightly biased above breakdown voltage at 77 K. The shape of short light pulses (τ=1 nsec) was determined by a delayed coincidence method, which accumulates the distribution of delay times between a light pulse and the following microplasma pulse. It is shown in a quantitative model that the time response of the detector is determined by minority carrier diffusion. Germanium avalanche diodes operating as photon counters with a delayed coincidence technique are suitable for detection of very short light pulses at low levels, and the shapes of fast signals can be detected despite relative long time constants of the detector. In order to reduce the necessary integration times, signal repetition rates up to ~100 kHz can be used. (auth)

29238 CHARGE COLLECTION IN SURFACE CHANNELS ON HIGH-PURITY Ge DETECTORS. Malm, H. L.; Dinger, R. J.

(Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 76-80(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Studies with collimated low energy gamma-ray beams show that for gamma-ray interactions within a "dead layer" of thickness about 1 mm at the surface of a Ge detector, the pulse height distribution is characteristic of single carrier collection. Independent measurements of the charge transport parameters also show that the majority carriers in the surface channel do not contribute to the charge pulse. (auth)

29239 ORIGIN AND CONTROL OF THE DOMINANT IMPURITIES IN HIGH-PURITY GERMANIUM. Haller, E. E.; Hansen, W. L.; Hubbard, G. S.; Goulding, F. S. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 81-87(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Techniques have been developed to consistently purify germanium to the 10^{10} atoms/cm^3 range. The major impurities are the acceptors boron and aluminum and the donor phosphorous. Formation of nonsegregating compounds of boron and aluminum make these elements difficult to remove by conventional zone refining whereas phosphorous and all other electrically-active impurities segregate normally and are therefore removed in the zone refining process. The only significant impurity introduced in our Czochralski crystal puller is phosphorous whose source has been traced to the quartz crucible. To reliably reduce impurity concentrations to acceptable levels it has been necessary to develop techniques for determining the types and concentrations of impurities in both the final single crystals and in the polycrystalline zone-refined ingots and to relate these results to the use of various boat and crucible materials. Photothermal Ionization Spectroscopy and electrical measurements have been used to identify and measure the impurities. (auth)

29240 RADIAL GRADIENT COAXIAL DETECTORS. Hall, R. N.; Soltys, T. J. (General Electric Corporate Research and Development, Schenectady, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 88-91(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Germanium crystals with radial impurity gradients have been prepared by diffusing Li into p-type material and then extracting most of it at the surface to produce n-core crystals. The diffusion is designed to produce coaxial detectors which reach full depletion at the inner and outer radii simultaneously, thereby minimizing the leakage which is caused by electrical stress at the electrodes. The depletion voltage and leakage current of these crystals are measured by methods which do not require that they be sectioned to expose the junction. Preliminary measurements of detectors made from radial gradient crystals are also reported. (auth)

29241 EFFECT OF DISLOCATION ON THE ENERGY RESOLUTION OF HIGH-PURITY GERMANIUM DETECTORS. Glasow, P. A. (Siemens Zentrale Forschung und Entwicklung, Erlangen, Ger.); Haller, E. E. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 92-96 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The energy resolution of high-purity Ge detectors depends on the dislocation density and distribution in the single crystal. This correlation could be shown in a number of planar detectors with different dislocation densities. Scanning with collimated electrons and gamma-rays revealed the strong dependence of local detector performance on dislocation density. (auth)

29242 CAPABILITIES OF MERCURIC IODIDE AS A ROOM TEMPERATURE X-RAY DETECTOR. Slapa, M.; Huth, G. C.; Seibt, W. (Univ. of California, Los Angeles). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 102-111(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Measurement results obtained with HgI_2 detectors at room temperature in the low energy x-ray region down to 2 keV are reported. The best resolution obtained is 548 eV for 5.9 keV x-rays, and the 2.01 keV phosphorous x-ray line has been resolved with a detector with an area of 14 mm^2. The different noise sources of the detector-amplifier system are analyzed and polarization effects in the detectors are discussed. The mercuric iodide crystals were grown from the vapor phase by gradient reversal techniques. (auth)

29243 THEORETICAL BAND STRUCTURE ANALYSIS ON POSSIBLE HIGH-Z DETECTOR MATERIALS. Yee, J. H.; Sherohman, J. W.; Armantrout, G. A. (Univ. of California, Livermore). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 117-123(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Theoretical energy band structure calculations have been utilized to investigate several high-Z materials for potential use as ambient temperature radiation detectors. Using the pseudopotential technique, the band structure for HgI_2 has been determined and the effective masses of the holes and electrons have been estimated. Theoretical mobilities of the electrons and holes as a function of temperature have been computed for HgI_2 and CdTe and are compared to experimental data. (auth)

29244 STUDY OF MERCURIC IODIDE DETECTORS BY PULSED LASER INDUCED PHOTOINJECTION TECHNIQUES. Watt, M. K.; Cho, Z. H. (Univ. of California, Los Angeles). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 124-130(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Some recent results of an investigation of carrier transport in mercuric iodide detectors, using the pulsed laser induced transient photoinjection technique are reported. These results include measurements of carrier mobilities, trapping times, and reduced mobilities, as well as some observations of polarization effects. The applicability of the transient photoinjection technique to the study of wide bandgap materials has been substantiated. (auth)

29245 COMPREHENSIVE MODEL FOR PREDICTING SEMICONDUCTOR DETECTOR PERFORMANCE. Swierkowski, S. P. (Univ. of California, Livermore). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 131-137(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A Monte-Carlo computational model has been developed to simulate the photon and electron spectral response in semiconductor detectors. Source photons from 10 eV to 1 GeV are three-dimensionally absorbed in detectors of almost arbitrary shape. One-dimensional charge collection in an arbitrary electric field profile includes trapping and electronics system effects. HgI_2, CdTe, and Ge spectra, as well as full energy peak and absorption efficiency calculations, are made into the MeV range. (auth)

29246 THIN ALL EPITAXIAL SILICON DETECTOR WITH INTERNAL AMPLIFICATION. Gruhn, C. R. (CERN, Geneva). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 145-152(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

An all epitaxial silicon avalanche diode (ESAD) having a total thickness of 36 mu (4×10^{-4} radiation lengths) has been fabricated. The design lends itself to the fabrication of thin detectors having an enhanced sensitivity to minimum ionizing particles. The uniformity of gain, signal to noise, and resolution of the detectors are studied. The response of the detector to minimum ionizing particles is measured. (auth)

29247 DEEP LEVELS AND COMPENSATION IN p-CdTe MATERIAL FOR gamma-RAY DETECTION. Martin, G. M.; Fabre, E.; Fogarassy, E.; Belin, C.; Ngo-Tich-Phuoc. (Lab. d'Electronique et de Physique Appliquee, Limeil-Brevannes, France). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 154-158(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A careful analysis of the data provided by different characterization techniques (time of flight and thermally stimulated current measurements) allows one to precisely anticipate the nuclear detection properties of a CdTe sample. The paper shows how energy resolution and detection efficiency can be correlated to some physical properties of the material. (auth)

29248 POLARIZATION IN CADMIUM TELLURIDE NUCLEAR RADIATION DETECTORS. Siffert, P. (Louis Pasteur Univ., Strasbourg); Berger, J.; Scharager, C.; Cornet, A.; Stuck, R.; Bell, R. O.; Serreze, H. B.; Wald, F. V. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 159-170(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Polarization has been studied in semi-insulating cadmium telluride compensated with chlorine. Several parameters have been considered including surface preparation, nature of the contact, temperature, as well as type and strength of the source. A model that assumes that the space charge region is produced by injected electrons being trapped by deep acceptors explains most of the effects observed. The possible nature of the center is discussed. Finally it is demonstrated that MIS structures are also a practical means to suppress the polarization. (auth)

29249 THERMALLY STIMULATED CURRENT MEASUREMENT OF TRAPS IN DETECTOR-GRADE CdTe. Barnes, C. E.

(Sandia Labs., Albuquerque, NM); Zanio, K. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 177-181(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Thermally stimulated current (TSC) has been measured in gamma detector-grade, high resistivity CdTe : In and CdTe : In, Cl. Electron mobility-trapping time products, mu tau, measured at room temperature correlate strongly with the shape and magnitude of a prominent TSC band observed at 40°K. This correlation is used as the basis for a simple method of selecting samples appropriate for detector applications. (auth)

29250 gamma-RAY DETECTION STABILITY UNDER TOTAL DEPLETION IN CdTe SURFACE BARRIER DETECTORS. Fabre, E.; Ngo-Tich-Phuoc; Martin, G. M.; Ortega, F. (Lab. d'Electronique et de Physique Appliquee, Limeil-Brevannes, France). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 182-184(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The paper presents an interesting way of overcoming the well-known "polarization effect" in Cl-doped CdTe detectors. The detection efficiency is kept constant as long as the sample remains totally depleted, even though hole detrapping may occur from deep levels. Excellent stability has been checked for periods of time up to half an hour. (auth)

29251 PHOTOMULTIPLIERS FOR HIGH-TEMPERATURE APPLICATIONS. Persyk, D. E.; Ibaugh, J. L.; McDonie, A. F.; Faulker, R. D. (Electro-Optics and Devices, Lancaster, PA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 186-188(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

High-temperature photomultipliers were studied to determine their performance characteristics as a function of temperature in the range of 20°C to 200°C. Photocathode sensitivity and thermionic emission were characterized. Pulse height, pulse-height resolution and plateau counting widths were studied with a simulated ^{137}Cs scintillation source. Room temperature performance was not significantly degraded after repeated cycling to 200°C. Detailed results are reported. (auth)

29252 READING DIELECTRIC TRACK DETECTORS USING TRANSMITTED PARTICLES. Dolce, S. R. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 206-210(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A new technique for measuring the number of tracks per unit area in a dielectric track detector uses the energy spectrum of alpha particles transmitted through the detector. The spectrum contains two components. One is a low-energy peak due to alpha particles transmitted through the bulk material. The other is due to higher energy alphas that are transmitted through craters and lose less energy. The ratio of the number of higher energy alphas to the total number of alphas in the spectrum gives the fraction of area occupied by craters and hence the track density. (auth)

29253 NUCLEAR RADIATION MEASUREMENT USING CHERENKOV LIGHT GENERATED IN A LIGHT GUIDE. Doyle, J. E.; Nelson, M. A.; Davies, T. J.; Franks, L. A. (EG and G Santa Barbara Operations, Goleta, CA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 211-213(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Cherenkov light pulses were generated in one end of 100-m lengths of multi-fiber cable and a single strand of graded index fibers by a 50-ps burst of 18-MeV electrons. Pulse dispersion in this length was between 3.5 and 2.9 ns for the cabled fibers and 4.1 ns in the single fiber. By narrow band optical filtering, the dispersion was reduced to values between 610 and 246 ps in the cable and 400 ps for the single fiber. Cherenkov sensitivity was measured for two of the fibers and found to be 6×10^{13} photons/sec and 6×10^{12} photons/sec for 50 ps electron bursts of 10 A/cm^2 and 6 A/cm^2 respectively. In terms of time response and sensitivity it appears feasible to design a nuclear explosive diagnostic system utilizing Cherenkov radiation generated in and transmitted by cables of graded index fibers. (auth)

29254 TRANSISTOR DESIGN CONSIDERATIONS FOR LOW-NOISE PREAMPLIFIERS. Fair, R. B. (Bell Labs., Reading, PA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 218-225(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A review is presented of design considerations for GaAs Schottky-barrier FETs and other types of transistors in low-noise amplifiers for capacitive sources which are used in nuclear radiation detectors and high speed fiber-optic communication systems. Ultimate limits on performance are evaluated in terms of the g/sub m//C/sub i/ ratio and the gate leakage current to minimize the noise sources. Si bipolar transistors and the future prospects of GaAs, Si and InAs MISFETs are discussed, and performance is compared to FETs currently being used in low-noise preamplifiers. (auth)

29255 POSITION SENSING BY CHARGE DIVISION. Alberi, J. L.; Radeka, V. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 251-258(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A summary of a comprehensive analysis of theoretical and practical aspects of position sensing by charge division from resistive electrodes is presented. Properties of transformer decoupling of the resistive electrode from detection bias voltage are analyzed and compared to the usual capacitive decoupling methods. Optimization and limitation of signal shaping is discussed as a function of diffusion time constant, signal rise times, and noise. (auth)

29256 COMPUTERIZED SYSTEM FOR AUTOMATIC FOIL COUNTING. Cohn, C. E.; Morman, J. A. (Argonne National Lab., IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 292-296 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A computer-based system for foil counting uses four sample changers with NaI and two with Ge(Li) detectors. The computer controls the sample changers, performs timing, operates a CRT display, acquires data from scalers and ADCs and writes data on magnetic tape. CAMAC is used for part of the system interfacing. (auth)

29257 WIDE RANGE COUNTING-CAMPBELLING NUCLEAR INSTRUMENTATION SYSTEM. Oda, M.; Wada, M.; Badono, S. (Mitsubishi Electric Corp., Amagasaki, Japan). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 304-306(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The feature of the present system is the use of the developed low noise current-sensitive preamplifier, counting loss compensation pulse rate-meter and fast response true-mean-square circuit. Noise level of the preamplifier is 10 PA/root Hz for 30 cable system. True mean square circuit operated at 100 KHz has a response time constant of 10 msec and a wide output range over 6 decades without level switching. (auth)

29258 MULTI-DETECTOR INTEGRATED FISSION COUNTER ARRAY. de Volpi, A.; Kaiser, W. C.; Eichholz, J. J. (Argonne National Lab., IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 307-310(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A multi-chamber fission array has been designed, fabricated, and tested with integrated and condensed electronic circuitry. The intention was to develop an array of over 100 channels of detectors able to cover the high power range of TREAT transients in conjunction with the fast neutron hodoscope. The array has been developed through a prototype stage consisting of 31 possible channels. A wide variety of operating conditions have been tested, including choice of fissile isotope, coating thickness, gas filling, plate spacing, high voltage, and electronic circuitry. The configuration tested at TREAT consisted of ten active channels incorporated in a doubly contained system. Miniaturized electronic circuits are appended almost directly to the parallel plates of the fission counters. Cost and space limitations were major factors in the design. (auth)

29259 DYNAMIC COMPENSATION OF RHODIUM SELF POWERED NEUTRON DETECTORS. Banda, L. A.; Nappi, B. L (Combustion Engineering, Inc., Windsor, CT). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 311-316(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A mathematical model of a rhodium self-powered neutron detector has been developed to investigate the detector transfer function and to apply this transfer function as compensation for the inherent time delay in the rhodium-neutron interaction. The various reactions that comprise the detector signal have been evaluated experimentally and the resultant transfer function compensation has been tested in the field against a prompt responding ion chamber during a reactor trip. (auth)

29260 DESIGN OF OPTIMIZED RC-CR FILTERS FOR CURRENT-PULSE OPERATION OF FISSION COUNTERS AND HIGH SENSITIVITY FISSION COUNTERS FOR HIGH GAMMA

BACKGROUNDS. de Lorenzo, J. T. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 331-341(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A calculational procedure was developed to design RC-CR filters for processing current pulses from fission counters in a gamma background ranging from 10^5 to 6×10^6 R/hr. The effects of noise from the gamma background and the input preamplifier and of the time constant of the fission counter and input cable were studied. Analytical results were in close agreement with experimental data. A pole-zero network was examined as a means of compensating for the time constant of the fission counter and input cable, but its improvement was insignificant. The procedure was expanded to design a high sensitivity, gamma-tolerant fission counter (approximately 10 counts sec^{-1} nv^{-1} at 10^5 R/hr), and the result was a conceptual design with a performance almost equal to a recently developed high temperature fission counter. (auth)

29261 LOCATION OF TRANSIENT GAMMA-RAY SOURCES WITH THIN FLAT SCINTILLATORS. Parnell, T. A. (Marshall Space Flight Center, Huntsville, AL); Gregory, J. C.; Kuo, T. L. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 476-479(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Thin flat slabs of scintillator are a useful means of measuring angular location of gamma-ray fluxes of astronomical interest. A statistical estimate of position error has been made of two scintillator systems suitable for gamma-ray burst location from a balloon or satellite platform. A single rotating scintillator with associated flux monitor is compared with a pair of stationary orthogonal scintillators. Position error for a strong burst is of the order of a few arcmin if systematic errors are ignored. (auth)

29262 HEAO-B IMAGING PROPORTIONAL COUNTER DESIGN. Harvey, P. (American Science and Engineering, Inc., Cambridge, MA); Sanders, J.; Cabral, R.; Morris, J.; Bjorkholm, P.; Ballas, J.; Jagoda, N.; Harnden, R. R. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 487-492(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The HEAO-B Imaging Proportional Counter is an X-ray imaging instrument designed for use in an orbiting observatory. It measures the spatial location and energy of individual X-ray photons by the risetime method and pulse height analysis respectively. The IPC can locate 0.1 to 4 keV photons to within 1 mm, and provides five bits of energy information. The IPC also includes an in-flight calibration source and a gas control system that maintains the counter gas density constant to an accuracy of 0.25 percent. (auth)

29263 MINIATURE HYBRID PREAMPLIFIER FOR CdTe DETECTORS. Baxter, R. D. (Aeronutronic Ford, Newport Beach, CA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 493-497 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Aeronutronic Ford has developed a rugged, miniature, room temperature operable, gamma ray detector package containing a CdTe photon detector, a charge amplifier and a pulse shaper circuit. Photon detection efficiencies between 10 percent and 40 percent are achieved for various photon energies between 100 keV and 1000 keV in a detector area of .032 square inches. The resulting package weighs approximately 8 grams and occupies approximately 0.1 cubic inch. Prototypes have been tested for aging and temperature effects on gamma detection efficiency. The intended application of the device is calibrated gamma ray counting in a warm environment while subjected to high intensity acoustic and vibration stresses as well as very large linear accelerations. (auth)

29264 LARGE FIELD IMAGE INTENSIFIER TUBE FOR SCINTILLATION CAMERAS. Driard, B.; Verat, M.; Rozieres, G. (Thomson-CSF, Paris). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 502-506(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The image intensifier tube opens a new era in scintigraphic diagnosis. The first results are very promising. Because of the image quality, tumors can be detected earlier than with other systems, and more details can be perceived. In the future the quality of the image can be further improved. (auth)

29265 APPLICATION OF A COMPUTERIZED IMAGE-INTENSIFIER RADIONUCLIDE IMAGING SYSTEM TO THE STUDY OF REGIONAL LEFT VENTRICULAR DYSFUNCTION. Kirch, D. L.; Steele, P. P.; LeFree, M. T.; Evans, P. L.; Stern, D. M.; Vogel, R. A. (Univ. of Colorado Medical Center, Denver). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 507-515(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A light-sensitive, self-scanning, silicon diode array has been used to interface an image-intensifier gamma camera to a digital computer for performing high resolution dynamic radionuclide angiocardiography. The spatial resolution of this image-intensifier camera (11C) system, which does not perform pulse-height analysis, is somewhat worse than that of the Anger camera (AC) at count-rates below 50 K cps. Between 50 K and 250 K cps the 11C demonstrates linear count-rate performance without the distortion and resolution loss associated with the AC. The ability of the 11C to maintain resolution at extremely high count-rates is of particular value for performing first transit, radionuclide bolus washout studies of cardiac dynamics. The high contrast and increased information density achieved by this approach provides accurate measurement of left ventricular volume and its first derivative with respect to time as verified by direct comparison with left cine ventriculography (cine). For the study of regional left ventricular wall motion, radionuclide images corresponding to end-diastole and end-systole have been used to compute functional images which accurately describe abnormally contracting segments of the left ventricular wall. The ability to study left ventricular volume and segmental wall motion without left heart catheterization is of significant diagnostic and investigative value. (auth)

29266 DESIGN CONSIDERATIONS FOR A POSITION EMISSION TRANSAXIAL TOMOGRAPH (PETT III). Phelps, M. E.; Hoffman, E. J.; Mullani, N. A.; Higgins, C. S.; Ter Pogossian, M. M. (Univ. of Pennsylvania, Philadelphia). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 516-522(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A whole body positron emission transaxial tomograph (PETT III) has been designed, constructed and is presently under clinical evaluation. The design of PETT III spatial resolution and sensitivity of annihilation coincidence detection (ACD), sampling considerations and importance of proper shielding are presented to evaluate some design considerations for an ACD tomograph. Tomographic studies of the brain and heart with human subjects are presented to demonstrate the image quality of PETT III under clinical conditions. (auth)

29267 CEREBRAL IMAGING USING ^{68}Ga DTPA AND THE U.C.S.F. MULTIWIRE PROPORTIONAL CHAMBER POSITRON CAMERA. Hattner, R. S.; Lim, C. B.; Swann, S. J.; Kaufman, L.; Perez-Mendez, V.; Chu, D.; Huberty, J. P.; Price, D. C.; Wilson, C. B. (Univ. of California, San Francisco). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 523-527(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A multiwire proportional chamber positron camera consisting of four 48 x 48 cm^2 detectors linked to a small digital computer has been designed, constructed, and characterized. Initial clinical application to brain imaging using ^{68}Ga DTPA in 10 patients with brain tumors is described. Tomographic image reconstruction is accomplished by an algorithm determining the intersection of the annihilation photon paths in planes of interest. Final image processing utilizes uniformity correction, simple thresholding, and smoothing. The positron brain images were compared to conventional scintillation brain scans and x-ray computerized axial tomograms (CAT) in each case. The positron studies have shown significant mitigation of confusing superficial activity resulting from craniotomy in comparison to conventional brain scans. Central necrosis of lesions observed in the positron images, but not in the conventional scans, has been confirmed in CAT. Modifications of the camera are being implemented to improve image quality, and these changes combined with the tomography inherent in the positron scans are anticipated to result in images superior in information content to conventional brain scans. (auth)

29268 PERFORMANCE PARAMETERS OF A POSITRON IMAGING CAMERA. Muehllehner, G.; Buchin, M. P.; Dudek, J. H. (Searle Analytic Inc., Des Plaines, IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 528-537(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Two Anger scintillation cameras have been combined into a positron imaging system. Count rate capability has been extended by using absorbers to reduce scattered radiation from the object, by using 1" thick crystals to improve detection efficiency for annihilation radiation, and by implementing pulse shortening techniques and low dead time D.C. coupled electronics. The main characteristics of the device in its present form are high

sensitivity (200 cts/sec/mu Ci), high resolution (system resolution less than 10 mm FWHM) and useful clinical count rates up to 8000 cts/sec. (auth)

29269 PROGRESS TOWARD A STABLE ORTHOGONAL STRIP GERMANIUM GAMMA CAMERA. Detko, J. F. (Memorial Sloan-Kettering Cancer Center, New York). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 538-542(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Following exposure to room ambient air, the radiation response of orthogonal strip detectors fabricated from high purity germanium for use in a gamma camera has been found to undergo deterioration due to changes which take place at the exposed surfaces between the electrode strips and at the edges of each device. Based upon data obtained from small test detectors subjected to a commercial passivation process, long term stability (greater than one year) following room ambient exposure appears feasible. (auth)

29270 HIGH-EFFICIENCY MULTIDETECTOR SYSTEM FOR TUMOR SCANNING. Kirby, J. A. (Univ. of California, Livermore); Phelps, P. L.; Armantrout, G. A.; Sawyer, D. Beck, R. N. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 543-548(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A high-efficiency detector system developed especially for medical imaging has three specially cut Ge(Li) coaxial detectors (total volume 249 cm^3). At 122 keV, the peak efficiency is 93 percent of that of a 7.6 x 7.6 cm NaI (Tl) detector. Degradation of the paralleled energy resolution is avoided and resolution is improved by 35 percent over that of conventional output-summing techniques by gating the detector outputs. In effect this multiplexes them to a single line output. (auth)

29271 MEASUREMENT OF SOFT TISSUE OVERLYING BONE UTILIZING BROAD BAND ENERGY SPECTRUM TECHNIQUES. Chan, J. L. H.; Alvarez, R. E.; Macobski, A. (Stanford Univ., CA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 551-554(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A system is described for measuring the amount of bone and soft tissue in a path through any point in a radiograph. The basic information required is the transmitted intensity with two different source spectra. It is shown experimentally that this data may be used to accurately calculate the bone and soft tissue thicknesses. (auth)

29272 AXIAL TOMOGRAPHY AND THREE DIMENSIONAL IMAGE RECONSTRUCTION. Chang, L. T.; MacDonald, B.; Perez-Mendez, V. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 568-572(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A number of existing cameras for Nuclear Medicine imaging of radio-isotope distributions give depth information about the distribution. These devices have in common that they provide tomographic images of the object, that is, that images of a given object plane have that plane in focus and all other object planes contribute an out-of-focus background superimposed on the in-focus image. We present here a method for three dimensional reconstruction of these axial tomographic images which removes the blurred off-plane activity from a number of transverse planes simultaneously. The method is applicable to a number of tomographic cameras, such as the multiple single-pinhole camera, the rotating slanted-hole collimator, the Anger focussing tomographic scanner, and the positron camera. The method can be implemented on a small computer having a disc system. (auth)

29273 IMPROVED DEPTH RESOLUTION IN CODED APERTURE gamma-RAY IMAGING SYSTEMS. Steinbach, A.; Macovski, A. (Stanford Univ., CA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 606-612(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

We derive a rigorous expression for the three-dimensional point response function associated with the combined encoding-decoding process of coded aperture imaging. From this general expression we derive the two-dimensional point response function appropriate to a coded aperture imaging system which images a two-dimensional source distribution. This point response function is then calculated numerically for a number of different aperture coding functions and decoding functions. The graphed results suggest that simple modifications of the decoding function can lead to significant improvements in the depth resolving capability of a coded aperture imaging system. Suggestions for future research are given. (auth)

29274 CIRCULAR RING TRANSVERSE AXIAL POSITRON CAMERA FOR 3-DIMENSIONAL RECONSTRUCTION OF RADIONUCLIDES DISTRIBUTION. Cho, Z. H.; Chan, J. K.; Eriksson, L. (Univ. of California, Los Angeles). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 613-622(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The transverse axial 3-dimensional image reconstruction concepts developed in transmission tomography brought the nuclear medicine and diagnostic radiology into the realm of quantitative analysis of the 3-dimensional image hitherto superimposed in two dimensions. Two factors make it appropriate to design a positron camera system at this time, (1) analogy between the emission of photons following a positron annihilation and the transmission of photons, and (2) the already demonstrated success of positron camera multidetector systems. The camera consists of one layer of 64 (or 72) NaI(Tl) crystals and PM tubes that simultaneously record coincidences from 2 x 736 (or 2 x 1116) detector combinations in a circular array. (auth)

29275 SPATIAL FREQUENCY RESPONSE OF ORTHOGONAL STRIP DETECTORS. Steidley, J. W.; Miller, D. W.; Schlosser, P. A.; Deutchman, A. H.; Gerber, M. S. (Ohio State Univ., Columbus). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 627-633(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The spatial frequency aliasing properties of orthogonal strip electrode, position sensing germanium detectors have been investigated both analytically and experimentally. The study demonstrates that aliasing is a property of strip electrode detectors but not necessarily a property of strip electrode cameras. Aliasing in gamma cameras can be eliminated using the collimator and spatial channel electronics as anti-aliasing spatial frequency filters. The system resolution of a strip electrode gamma camera is determined by the collimator resolution and the intrinsic detector resolution. The collimator resolution is a function of the source depth while the intrinsic detector resolution is a function of the strip width spacing and the spatial channel readout electronics. The elimination of aliasing limits the overall spatial resolution of a camera to 1.7 to 2.3 times the strip width spacing depending on readout technique. It should be noted that this is not the intrinsic detector resolution but rather the camera resolution at the source depth for which the collimator is designed. The spatial resolution at depth for first generation clinical germanium cameras is anticipated to be from 1.7 mm to 4.6 mm. (auth)

29276 HIGH EFFICIENCY COLLIMATOR-CONVERTERS FOR NEUTRAL PARTICLE IMAGING WITH MWPC. Chu, D. (Univ. of California, Berkeley); Tam, K. C.; Perez-Mendez, V.; Lim, C. B.; Lambert, D.; Kaplan, S. N. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 634-639(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A MWPC with external collimator converter system has been developed specifically for the detection of 0.511 MeV gammas in a positron camera. The design basis is applicable also to the imaging of other gammas and neutrons. The converter consists of honeycomb cells which provide an enhanced area of escape surface as well as restricting the range of conversion electrons to the cell dimensions. (WHK)

29277 PROPORTIONAL CHAMBER GAMMA CAMERA. Jeavons, A. P.; Cate, C. (CERN, Geneva). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 640-644(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The theoretical and experimental design of a proportional chamber gamma camera using the high-density drift space principle is outlined, for photon energies greater than 100 keV. Detection efficiencies of 50 percent or more are possible, using two converters, combined with a spatial resolution of 1 mm. Energy resolution is, however, poor. Experimental results of imaging are given. (auth)

29278 OFF-LINE PERIPHERALS FOR MULTIPLE CAMERA-COMPUTER INTERFACES. Cahill, P. T.; Ornstein, E.; Bietry, R. (Polytechnic Inst. of New York, Brooklyn). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 651-654(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A solution to the problem of data acquisition and processing from multiple cameras via a single computer is presented and discussed. Off-line disc systems or video tape peripherals provide greater speed of data collection, increase the total throughput of the camera-computer system, and provide backup in case of computer breakdown. They increase the efficiency of a single

computer, thus minimizing the cost of data acquisition and analysis. (auth)

29279 IN SITU DETERMINATIONS OF ENVIRONMENTAL PLUTONIUM AND ITS RELATED NUCLIDES. Beck, H. L.; McLaughlin, J. E.; Miller, K. M. (Energy Research and Development Administration, New York). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 676-682(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The design requirements for an in situ transuranic detector are defined based on the properties of the expected radiation fields. The need for such a detector, limitations of present methods, and reasons for these limitations are also discussed. Some possible new approaches (at least as applied to this problem) are indicated. (auth)

29280 ZPR-9 AIRBORNE PLUTONIUM MONITORING SYSTEM. Rusch, G. (Argonne National Lab., IL); McDowell, W. P.; Knapp, W. G. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 690-693(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

This paper describes an airborne plutonium monitoring system which is installed in the ZPR-9 (Zero Power Reactor No. 9) facility at Argonne National Laboratory. The design and operational experience are discussed. This monitoring system utilizes particle size and density discrimination, alpha particle energy discrimination, and a background-subtraction technique operating in cascade to separate airborne-plutonium activity from other, naturally occurring, airborne activity. Relatively high sensitivity and reliability are achieved. (auth)

29281 STABILIZED SCINTILLATION CRYSTAL SYSTEM FOR MONITORING GAMMA RAY EXPOSURE IN THE ENVIRONMENT. Lucas, A. C.; Shoffner, B. M. (Harshaw Chemical Co., Solon, OH). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 699-703(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A 2 inch Na(Tl) scintillator has been incorporated into a remote real time monitor for gamma ray background. The scintillator contains a small ^{241}Am source which provides a high energy reference pulse for maintaining system gain. Gain is maintained automatically by a variable gain linear amplifier at the central station. The detector is connected to the central station by a single coaxial line which passes both the high voltage and the signal. Gamma ray pulses are processed in a modified Wilkinson analog to digital converter to provide an output count rate proportional to exposure rate (microR/hour). The system has been shown to be stable against temperature change, to be independent of gamma ray energy in the range 0.1 to 2.0 MeV, and to be useful in the range 1.0 to 10,000 microR/hour. (auth)

29282 USE OF A MICROPROCESSOR IN A REMOTE WORKING LEVEL MONITOR. Keefe, D. J.; McDowell, W. P.; Groer, P. G. (Argonne National Lab., IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 704-709(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The instrument described measures the short-lived ^{222}Rn-daughter concentrations and the Working Level (WL) in sealed "hot chambers" located in uranium mines. Radiation-induced pulses from two separate sensors are transmitted through 500 ft. cables to a microprocessor, which processes the pulses and controls the operation of the system. A read-only memory stores a fixed program which is used to calculate the desired concentrations. The results are printed as pCi/l (Rn-daughter concentrations) and WL. (auth)

29283 MICROPROCESSOR BASED ENVIRONMENTAL RADIATION MONITORING SYSTEM. McCormick, D. J.; Glesius, F. L.; Kroon, J. C. (Reuter-Stokes, Inc., Cleveland). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 710-714(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A multisensor environmental radiation monitoring system utilizing pressurized ionization chambers is described. The system is capable of measuring incremental increases in gamma radiation exposure of the order of 1 mrad/year due to gaseous effluents from nuclear power plants. Continuous monitoring at a number of sites at or beyond the reactor boundary is performed automatically under control of a microprocessor-based central data acquisition facility. The exposure rate record from each sensor is reduced to a convenient form which can be used to easily determine the reactor plume contribution to the total exposure. (auth)

29284 PROPORTIONAL COUNTER FOR MONITORING LOW LEVELS OF ^{85}Kr AND OTHER BETA- AND X-RAY-EMITTING NUCLIDES. Gregory, J. C. (Univ. of Alabama, Huntsville); Parnell, T. A. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 715-718 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The use of the inert radioactive gas ^{85}Kr for tracer studies, leak detection, etc., will become more widespread as the sensitivity of available detectors increases. A multiwire multiplane proportional counter system for beta detection has been developed with a measured minimum detectable concentration for a 3-minute count of 3×10^{-3} pCi cm^{-3} of ^{85}Kr in a semi-infinite cloud. Larger proportional counters operated for counting times of several hours can reduce this limit to below 1×10^{-4} pCi cm^{-3}. These detectors should be useful in monitoring low levels of the radioactive inert gases and of x-ray emitting nuclides. (auth)

29285 NEW NEUTRON-FLUX DETECTION METHOD FOR FISSION CHAMBER COUNTING SYSTEMS. Hasegawa, K. I.; Kimura, Y.; Sekiguichi, A. (Tokyo Univ.). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 833-838(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A new counting method for a detection system using a fission chamber placed under high neutron-flux is presented. This method is based on the fact that pile-up of pulses delivered by the fission chamber produces a linear relation on log-log scale between the neutron-flux and the threshold voltage of an amplitude discriminator, when a count-rate of output pulses of the discriminator is maintained at a constant value. The fact has been verified by a theoretical approach using a simple model. A counting system with a negative feedback loop has been constructed to carry out this constant count-rate amplitude discrimination. Experimental results obtained by utilizing a small fast reactor show that the system can cover a wide range of the reactor power. (auth)

29286 MAXIMUM A POSTERIORI ESTIMATION OF POSITION IN SCINTILLATION CAMERAS. Gray, R. M.; Macovski, A. (Stanford Univ., CA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 849-852(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

We derive the form of the maximum likelihood (ML) estimate of the location of the scintillation point given the photomultiplier counts in an Anger scintillation camera. This estimate is also Maximum a Posteriori (MAP) if the prior probability density on the scintillation point is uniform in the object plane. The form of the estimate suggests the possibility of an optical filtering implementation. We note that the ML estimate implies a solution that is remarkably similar to the "optimum position arithmetic" derived by Tanaka, et al. (auth)

29287 TWO-RANGE TRACK DOSIMETER. Roginets, L. P.; Yaroshevich, O. I.; Malykhin, A. P.; Zhuk, I. V. (Inst. Ser. Fiz.-Energ. Navuk; No. 4, 5-7(1975). (In Russian)

The possibility of creation of the second diapasone, shifted to a greater radiation dose in a solid state track dosimeter is shown. The second diapasone is formed by the partial closing of detector surface by the absorber, which reduce the fluence of incident fission fragments. With the single etching and with the same radiator and detector the upper limit of measurable dose in this case is raised up to 10^2 times as the lower limit is retained the same. An increasing of the upper limit of measurable dose up to $3,42 \pm 0,03$ and $52,6 \pm 2,5$ times for a "thick" uranium radiator, mica detector and macrofol absorber with thicknesses of 0,735 mg/cm^2 and $2 \times 0,735$ mg/cm^2 respectively is experimentally obtained.

Radiation Dosimeters

Refer also to abstracts 29609, 30192, 30290, 31968, 31969, and 31975.

29288 A γ RADIATION DOSIMETER WITH A LOW NEUTRON RESPONSE. Ewen, K. (Gewerbeaufsicht des Landes Nordrhein-Westfalen, Duesseldorf (F. R. Germany). Zentralstelle fuer Sicherheitstechnik, Strahlenschutz und Kerntechnik). Kerntechnik; 17: No. 11, 487-488(Nov 1975). (In German, English)

2 tabs.; 2 refs.

A new γ radiation dosemeter is described. It is based on a liquid scintillator containing the solvent hexafluorobenzene (C_6F_6) as main component. This dosemeter has a substantially higher response to γ radiation than that of an ionization chamber, without the disadvantages of a high response to neutrons typical of γ

radiation detectors based on scintillators and on semiconductors. This dosemeter is therefore suitable for mapping γ radiation dose rate levels in mixed γ radiation and neutron fields in the vicinity of nuclear reactors and particle accelerators. (DE)

29289 EVALUATING THE FAST NEUTRONS'S QUALITY FACTOR BY MEANS OF THE ROSSI COUNTER. Bregadze, Yu. I.; Maslyaev, P. F. Meas. Tech. (USSR) (Engl. Transl.); 18: No. 7, 1080-1083(Jul 1975).

Translated from Izmer. Tekh.; 18: No. 7, 79-81(Jul 1975).

A LET spectrometer utilizing a Rossi counter for evaluating fast neutron quality factor is described. The Rossi counter has an internal diameter of 55 mm and 3-mm walls made of tissue-equivalent plastic. The spectrometer is intended for testing fast neutron equivalent-dosemeters used in radiation safety analysis. (WHK)

29290 USE OF MICROWAVE METHODS IN DOSIMETRY OF IONIZING RADIATION FLOWS. Medvedev, Yu. A.; Morozov, N. N.; Stepanov, B. M.; Khokhlov, V. D. At. Energ. (USSR); 40: No. 1, 53-55(Jan 1976). (In Russian)

A new method for determining the single-pulse exposure dose of ionizing radiation, based on microwave measurement of the imaginary part of ionized-air complex-conductivity, is proposed. Theoretical and experimental studies of the effect of nonequilibrium in the energy spectra of secondary electrons due to the action of a non-stationary radiation source on electro-physical plasma parameters were carried out. It is shown that providing $\omega \gg \nu_{eff}$, where ω is the cyclic frequency of electromagnetic field and ν_{eff} the effective electron collision frequency, the imaginary part of conductivity is independent of the energy distribution function of electrons. It is also shown that for ionizing radiation pulses of duration less than the characteristic electron life in air the imaginary part of conductivity is proportional to the exposure dose. Experimental data confirming the feasibility of SHF methods in the dosimetry of penetrating radiation flows are presented.

29291 DAMAGE EFFECTS IN THERMOLUMINESCENT LiF TLD-PHOSPHOR. Jain, V. K.; Kathuria, S. P. (Bhabha Atomic Research Centre, Bombay, India). pp 219-225 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The thermoluminescence (TL) response to gamma rays of the most sensitive glow peaks in LiF(viz. II, III and V) reaches a maximum and then decreases instead of remaining constant. The decrease in response is attributed to radiation damage. It is observed that even after considerable reduction in the TL, as a result of heavy dose and consequent damage, the saturation exposure for these peaks remains the same. However by redistributing the traps amongst the peaks by pre-annealing at 200°C for 23 hours, the saturation exposure can be altered. Since saturation exposure is indicative of the availability of trap centres, it is suggested that radiation damage in LiF is due to decrease in the availability of luminescence centres. The decrease could be due to the aggregation of simple luminescent centres into complex centres. (auth)

29292 LET DEPENDENCE OF THERMOLUMINESCENCE GLOW CURVE OF LiF TLD-PHOSPHOR. Jain, V. K.; Kathuria, S. P. (Bhabha Atomic Research Centre, Bombay, India). pp 226-233 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The thermoluminescence glow curve of lithium fluoride dosimetry powder was recorded for alpha radiation, gamma-rays and x-rays of different energies. It is observed that the structure of the glow curve is the same for all the radiations in as much as all the peaks are present. However, the relative heights of different peaks show marked LET dependence. Thus the ratio of peak V height (185°C) to peak VIII height (235°C) and also the height of peak II is very much LET dependent. In fact all the higher temperature peaks relative to peak V are higher for alpha-radiation than for gamma rays. Further these peaks are much more supralinear for gamma rays than for alpha-rays. The possibility of the higher temperature peaks being due to traps capturing multiple charges is discussed. (auth)

29293 TEN YEARS OF RADIATION MONITORING EXPERIENCES USING THERMOLUMINESCENT DOSIMETERS. Sunta, C. M. (Bhabha Atomic Research Centre, Bombay). pp 389-403 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Health Physics Division of BARC has developed a simple TLD system and has been using it for the last ten years in a variety of applications in radiation dosimetry. Dosimeters have been fabricated in a number of shapes to suit specific applications: finger and wrist PVC sachets, rigid metal-bound strips, encapsulations in metal, glass PVC containers etc. Experiences have also been accumulated in the use of various phosphors like CaF_2, $CaSO_4$ and LiF. Some of the highlights of our applications have been (i) environmental monitoring inside BARC; (ii) population exposure evaluation in monazite areas of the Kerala sea-coast; (iii) pre and post-operational environmental radiation surveys around nuclear power stations; (iv) isodose mapping of panoramic irradiation facilities; and (v) estimation of radiation levels for reactor fuel handling and storage. Recently attempts have been made: (i) in routine personnel monitoring for occupational workers on the same lines as the existing film badge service; (ii) in evaluating radiation levels around Plasma-Torch-welding operations; (iii) in the estimation of UV radiation levels in gas-welding operations; and (iv) in participating in the TLD intercomparison program organized by the University of Texas. Results of these are presented and discussed. (auth)

29294 DEVELOPMENT OF GLASS ENCAPSULATED $CaSO_4$:Dy AND $Li_2B_4O_7$:Mn CAPILLARIES AND THEIR TL CHARACTERISTICS. Pradhan, A. S.; Ayyangar, K.; Madhvanath, U. (Bhabha Atomic Research Centre, Bombay, India). pp 404-408 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Glass encapsulated $CaSO_4$:Dy and $Li_2B_4O_7$:Mn capillaries have been developed using phosphors prepared in the Division. Their suitability for dosimetry and environmental radiation surveillance was investigated. The minimum gamma ray exposure measurable with $CaSO_4$:Dy dosimeters was 5 mR and with $Li_2B_4O_7$:Mn 100 mR with a precision of ± 5%. Various parameters such as the accuracy, precision, sensitivity, energy dependence, effect of light and reusability were investigated. Selected dosimeters of this type can be used for accurate determination of radiation levels if certain precautions on light exposure and annealing etc. are taken. (auth)

29295 DEVELOPMENT OF $CaSO_4$:Dy TEFLON DISCS FOR THERMOLUMINESCENCE DOSIMETRY. Pradhan, A. S.; Chandra, B.; Ayyangar, K. (Bhabha Atomic Research Centre, Bombay, India). pp 409-413 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Phosphor embedded teflon discs have several advantages such as ease of handling, good reproducibility and possibility for identification of individual dosimeters over loose powder and other forms. Different moulding techniques were used and a suitable method was arrived at. This study reports the dosimetry characteristics obtained with teflon discs of 11.8 mm dia and 0.8 mm thickness containing 20% of $CaSO_4$:Dy by weight. The minimum measurable exposure was f[illegible] to be 5 mR and the precision at this level was ±8% using [illegible] gas flow. The energy response of the discs was investigated down to 30 keV. Other parameters such as annealing and reusability are also discussed. (auth)

29296 USE OF THERMOLUMINESCENT DOSIMETERS FOR MEASUREMENTS OF GONAD DOSES IN DIAGNOSTIC X-RAY PROCEDURES. Viswanathan, P. S.; Ayappan, P.; Sesane, J. B. (Bhabha Atomic Research Centre, Bombay, India). pp 414-422 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Among the man-made radiation sources diagnostic X-rays contribute the maximum dose to the genetic dose. Several workers have attempted to measure the gonad doses received by patients undergoing diagnostic X-ray procedures using ion chambers and photographic films. In the present work an attempt has been made to measure these doses on phantom as well as patients, using thermoluminescent dosimeters, the main advantage of these dosimeters being their small sizes. $CaSO_4$:Dy was selected as the dosimeter phosphor for the present use because of the following reasons: (1) The sensitivity of this phosphor is quite high and it can record even very low doses (2) the response of the dosimeter did not vary more than ± 6% from the mean value in the kV range

of 50 to 100. Using REMAB and Mix-D phantoms and a diagnostic X-ray machine, the skin and gonad doses received during different types of X-ray examinations were measured both using TLD and ion chamber. The measurements were also conducted on patients undergoing X-ray diagnostic examinations in the local hospitals of Bombay. The results of these measurements are presented and discussed. (auth)

29297 APPLICATION OF THERMOLUMINESCENT DOSIMETERS IN COBALT-60 BEAM THERAPY. Viswanathan, P. S.; Sasane, J. B.; Ayappan, P. (Bhabha Atomic Research Centre, Bombay, India). pp 423-428 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

In the treatment of cancer-patients using Co-60 teletherapy units, certain basic data like central axis depth dose and isodose curves are required for the purpose of treatment planning. These are either computed or experimentally measured using ionization chambers and photographic films. The ion-chamber measurements result in certain error or uncertainty because of their sizes especially in rapidly varying fields. Thermoluminescent dosimeters with their small sizes are good substitute on such situations. Using lithium fluoride (TLD-100) dosimeters, central axis depth dose measurements were done for different field sizes of a teletherapy Co-60 beam in a Mix-D phantom. Using the above dosimeters isodose curves were generated for special modified fields resulting from the use of wedge filters and split-field blocks for different types of cobalt units. Use of these dosimeters for checks of radiation field sizes on teletherapy units are also demonstrated. (auth)

29298 ULTRAVIOLET RESPONSE OF $CaSO_4$:Dy. Chandra, B.; Ayyangar, K.; Lakshmanan, A. R. (Bhabha Atomic Research Centre, Bombay, India). pp 439-445 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

A simple method for measuring UV exposure using the thermoluminescent properties of $CaSO_4$:Dy is presented. Three peaks at 145°C, 215°C and 365°C were observed in general by UV irradiation of virgin phosphor. The peak at 365°C was found to be very small and the peak at 145°C fades away within a week. No appreciable fading was observed for the 215°C peak. Further the peak at 215°C was found to coincide with the gamma dosimetric peak. This peak was chosen for UV exposure measurements. A standard quartz penray lamp was used for calibrating the phosphor both by peak height measurement and by integration. The dosimetric peak has been found to be linear from the detection threshold of 400 ergs/mm^2 to 4×10^4 ergs/mm^2. Beyond this exposure the phosphor behaved supra linearly to UV exposure up to the studied range of 5×10^5 ergs/mm^2. The phosphor exhibited strong energy dependence to different photon energies. The TL sensitivity increases sharply by a factor of 300 as the wavelength is decreased from 250 nm to 200 nm. The response is negligibly small above 350 nm. Other important characteristics like particle size dependence, fading characteristics, thickness dependence, re-usability etc. are also presented. The UV sensitivity increased by a factor of 3 when the grain size range is varied from 105 to 210 μm to 0 to 37 μm. Self shielding by a factor 2 was observed when the sample thickness was increased from 10 mg/cm^2 to 72 mg/cm^2. (auth)

29299 THERMOLUMINESCENCE RESPONSE OF $CaSO_4$:Dy AND $Li_2B_4O_7$:Mn TO POLONIUM-210 ALPHA RADIATION. Lakshmanan, A. R.; Ayyangar, K. (Bhabha Atomic Research Centre, Bombay, India). pp 446-451 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The thermoluminescent response of $CaSO_4$:Dy and $Li_2B_4O_7$:Mn to ^{210}Po alpha relative to ^{60}Co gamma radiation was obtained using samples which are thin compared to the range of alpha particles. The samples were prepared by depositing fine grain phosphors (1-8 μm) from acetone suspension onto aluminium discs. The average sample thickness obtained by this method was around 1 mg/cm^2. Thermoluminescence was recorded by placing these discs on the heater tray of the TLD reader fabricated in this laboratory. The alpha irradiations were made with a ^{210}Po disc source having an active area of 50 mm in diameter, and sample to source gap of 1.2 mg/cm^2. The dose rate in air from the disc was measured using an extrapolation ionization chamber and found to be 234 rad/min. The absorbed dose in TL samples was obtained from this value by multiplying with stopping power ratios of the TL materials to air. No change in glow peak structure between alpha and gamma irradiation was observed for these materials. Alpha growth curves of both these materials were found linear in the dose range studied (10^1 to 10^4 rad). The alpha efficiency was found to be 29% for $CaSO_4$:Dy and 37% for $Li_2B_4O_7$:Mn as compared to ^{60}Co gamma radiation. (auth)

29300 ADDITIVITY OF ALPHA AND GAMMA RESPONSE IN $Li_2B_4O_7$:Mn. Ayyangar, K.; Chandra, B.; Pradhan, A. S.; Lakshmanan, A. R. (Bhabha Atomic Research Centre, Bombay, India). pp 452-458 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

It is well known because of supralinear response of TL material that equal TL outputs are not obtained for equal increments of exposure. Thus for most phosphors additivity does not hold for gamma exposure. However, earlier investigation on thermal neutron response of $Li_2B_4O_7$:Mn showed that additivity holds for thermal neutron and gamma exposures. The phenomenon was explained on the basis that the high LET radiation from $^{10}B(n,\alpha)^7Li$ reaction and the low LET gamma radiation interact independently. Another study was undertaken to support this with alpha and gamma rays. A curium alpha disc source with a surface dose rate of 2.9 k rad/min was used for alpha exposures. $Li_2B_4O_7$:Mn of grain size, 105-106 micron was chosen for the study. Results of TL measurements indicated that additivity holds between these two radiations and the TL output remained the same whether the alpha exposure was given first or after the gamma exposure. Because of the existence of the supralinear region beyond 10^2R of gamma rays, one would expect higher TL output for $(\alpha + \gamma)$ exposure on the basis of individual calibration plots. As this was not observed, it was concluded that the space taken up by alpha interaction is negligibly small and does not interfere with the gamma exposure resulting in additivity. No memory effect was observed up to the alpha exposure of 3×10^6 rads studied. (auth)

29301 ROLE OF THERMOLUMINESCENCE DOSIMETERS IN INDUSTRIAL RADIATION HAZARD CONTROL. Murthy, B. K. S.; Negi, B. S.; Gangadharan, P. (Bhabha Atomic Research Centre, Bombay, India). pp 459-468 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The applications of thermoluminescent dosimeters in industrial radiation safety are described. The measurements involve leakage radiation levels around source containers such as radiography equipment, radioisotope gauges, level indicators, etc., area survey of industrial installations, air scatter exposure rates in the vicinity of open top radiography rooms, and estimation of activity of source. Dysprosium activated calcium sulphate TL phosphor in the form of phosphor filled glass capillaries and the TL reader developed in our laboratories have been employed in all these measurements. Wherever possible, the results are compared with measurement by other systems such as survey meters and film badges. The scope of the TLD in the field of industrial radiation safety and the advantages of this system over other systems are indicated. (auth)

29302 TLD METHOD FOR THE DETERMINATION OF X-RAY QUALITY AND OUTPUT IN THE DIAGNOSTIC RANGE. Ayyangar, K.; Chandra, B.; Pal, M. (Bhabha Atomic Research Centre, Bombay, India). pp 469-474 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

A simple TLD method is described for the simultaneous determination of HVT and output of diagnostic X-ray machines. Thermoluminescent $Li_2B_4O_7$:Mn phosphor sealed in polythene bags and attached to four 0.7 mm thick aluminium sheets as a step wedge was used as a compact packet and exposed to various energies of X-rays. The TL output was measured and plotted against thickness of Al and the HVT determined. Comparisons made with the usual aluminium wedge and X-ray dosimeter data showed agreement within ±5% in the range of 40 to 130 kV. The HVT-TL-dosimeter wedge is convenient for handling and suitable especially for making measurements remotely by mail. (auth)

29303 BACKSCATTERED SECONDARY ELECTRON DOSIMETRY USING THERMOLUMINESCENT DOSIMETERS. Murthy, M. S. S.; Lakshmanan, A. R. (Bhabha Atomic Research Centre, Bombay, India). pp 475-481 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

When a high atomic number material intercepts the stream of secondary electrons liberated in an irradiated medium, it can backscatter a significant fraction of the incident electrons. This can considerably increase the dose at the interface. For the purpose of measuring this excess dose at the interface thin layers of $Li_2B_4O_7$: Mn and $CaSO_4$: Dy thermoluminescent materials were prepared by depositing fine grains of the phosphor from acetone suspension onto aluminium discs. The thickness of these samples was 3.3 mg/cm^2 for $Li_2B_4O_7$:Mn and 1.3 mg/cm^2 for $CaSO_4$:Dy. These discs can be directly placed on the heater tray of a TL reader and are amenable to annealing and repeated use. These investigations show that (1) the backscattered electrons at the interface of perspex (irradiated by ^{60}Co gamma rays) and silver have a wide range of energies. The maximum energy has been estimated to be 600 keV. This is considerably less than the maximum energy of the equilibrium secondary electron spectrum generated by ^{60}Co gamma rays in perspex. (2) The backscattered electron dose at the interface increases rapidly with the atomic number of the scatterer. It is more than a factor of two for lead. (3) However, this dose decreases steeply with increasing gap at the interface. Because of the short range of these backscattered electrons, they make a significant contribution to total dose only in the irradiation of thin biological samples. These findings have been applied to a specific case of biological irradiation. (auth)

29304 APPLICATION OF TLD IN BRACHYTHERAPY DOSIMETRY. Santhamma, A. V.; Das, K. R.; Hatimbhai; Jayaraman, S.; Philip, P. C.; Iyer, P. S. (Bhabha Atomic Research Centre, Bombay, India). pp 482-493 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Thermoluminescent dosimeters are used in a variety of situations to determine the dose distributions in the field of brachytherapy. These dosimeters offer the advantage of approximating point detectors and facilitate dose measurements in the volume of interest surrounding the sources. The experimental results for dose distributions in phantoms for (1) single line sources, (2) array of line sources such as those in the Manchester system of intracavitary applications and (3) Cathetron, which is a remotely controlled afterloading applicator are presented. Both lithium fluoride and lithium borate have been used as phosphors in these studies. The experimental results have been found to agree well with the theoretically expected values. The application of these dosimeters for in vivo dosimetry is discussed. (auth)

29305 ASSESSMENT OF SKIN DOSE AND DOSE BUILD-UP IN ^{60}Co AND ^{137}Cs BEAM THERAPY USING LiF AND $Li_2B_4O_7$ THERMOLUMINESCENT DOSIMETERS. Jayaraman, S.; Das, K. R.; Sasane, J. B.; Beniwal, A.; Ali, M. A. (Bhabha Atomic Research Centre, Bombay, India). pp 494-503 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

LiF and $Li_2B_4O_7$ dosimeters in the phosphor form were employed for the purpose of studying the dose gradient in the build-up region for ^{60}Co and ^{137}Cs teletherapy beams. The variation of skin dose with the change of position with respect to skin of the secondary electron filter generally used to reduce the electron contamination has been investigated for various field sizes of ^{60}Co. The relative magnitudes of skin doses for different modes of irradiation with beam limiting cones and diaphragms have been investigated for ^{137}Cs teletherapy unit. (auth)

29306 ENERGY DEPENDENCE OF TL MICRORODS OF LiF IN TEFLON MATRIX FOR HIGH ENERGY ELECTRONS. Philip, P. C. (Bhabha Atomic Research Centre, Bombay, India). pp 504-509 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The response of TLD LiF is independent of energy for X and gamma rays in the region beyond 100 keV. However, with high energy electrons, LiF exhibits some energy dependence. This paper presents the results of the study of energy dependence of TL microrods of LiF in a teflon matrix (MR-LiF-7) to high energy electron beams of energy ranging from 8.4 MeV to 25.6 MeV. It has been found from theoretical calculations and experimental verification that the energy response of these dosimeters decreases as the electron energy increases. With electrons of energy 25.6 MeV, the response relative to ^{60}Co gamma radiation is less by about 10%. The energy response of LiF alone is also separately calculated. It is seen that the presence of teflon has not altered the energy response of the dosimeter. (auth)

29307 FINGER DOSIMETRY OF RADIATION WORKERS WITH TL PHOSPHORS. Reddy, A. R. (Inst. of Nuclear Medicine and Allied Sciences, Delhi); Ayyangar, K.; Pradhan, A. S. pp 510-520 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Radionuclides such as ^{113m}In and ^{99m}Tc which are widely used in nuclear medicine procedures present the possibility of larger radiation doses to the finger tips of the radiation workers concerned with their production, tagging, dispensing, injecting, etc. In this study these finger doses are measured. Also the doses at three different locations on the surface of syringes of four different volumes containing some activity of ^{99m}Tc or ^{131}I in the same volume are measured using $CaSO_4$: Dy. The phosphor is contained in either a glass capillary of 10 mm length and 2 mm diameter or in a small polythene bag (area 1 cm^2). The TL response, corrected for energy dependence, is converted to radiation dose (cumulative for some operations) in mrads and then to dose rate in mrad per mCi-min to normalize for the activities and times involved in different operations. The present measurements indicated that workers preparing radiopharmaceuticals received higher doses (maximum 2.2 rad with ^{99m}Tc) than those dispensing and injecting them to patients (maximum 400 mrad with ^{113m}In). The dose rates at different locations on the surface of syringes of 1 ml and 10 ml volume are practically the same (around 27 and 15 mrad per mCi-min for ^{131}I and ^{99m}Tc respectively at the needle end of the syringe). There does not seem to be much advantage from the point of view of dose reduction to finger tips to use a big size syringe for dispensing and injection. (auth)

29308 THERMOLUMINESCENCE GLOW CURVE RECORDER. Bhasin, B. D. (Bhabha Atomic Research Centre, Bombay). pp 533-545 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

This paper describes a glow curve recorder for thermoluminescence (TL) studies. The complete system consists of a linear temperature programmer, heating chambers with provision to control the atmosphere, a photomultiplier housing with cooling arrangements to reduce the dark current incorporating a double pane insulating window to avoid frosting, a high input impedance D. C. amplifier and a null-balancing potentiometric recorder with fast pen speed. The linear temperature programmer provides both linear heating for glow curve recording and linear cooling for annealing studies, besides isothermal operations up to 700°C. Heating rates can be varied from 10°C/min to 100°C/min. The reader-head design accepts readily changeable chambers for heating the TL phosphors in any desired atmosphere. Light guide and suitable optical filters with baffles to cut off thermal radiation are also provided in the present set-up. A few typical glow curves taken with this recorder are presented. (auth)

29309 STABLE AND LOW COST LIGHT EMITTING DIODE LIGHT SOURCE FOR TLD READER CALIBRATION. Sankaran, A.; Kannan, S. (Bhabha Atomic Research Centre, Bombay). pp 553-562 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The various methods to check the long term stability of a PM tube measuring system in TLD readers are discussed. These methods include use of radioactivity light standard sources, Cherenkov sources, and filament lamps. The merits and demerits of each of these systems are critically reviewed. The report finally describes a novel stable checklight source using a low cost commercially available light emitting diode. The advantages of this system are long life, easy availability of LED's having various spectral emissions, and small size. It has been shown that the temperature effects can be made negligible by operating the diode under "near constant current" conditions. The long term stability of the light source has been checked and found to be better than ±0.5% per month. (auth)

29310 SEMI-AUTOMATIC TLD PERSONNEL MONITORING BADGE PROCESSOR FOR ROUTINE USE. Gangadharan, P.; Sankaran, A.; Kannan, S. (Bhabha Atomic Research Centre, Bombay). pp 563-579 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

This paper describes a semi-automatic TLD reader developed for large scale processing of personnel monitoring badges. The instrument consists of a sliding drawer on which the TLD badge card can be placed and heated. The heater is a movable kanthal strip which can be pressed against any one of three $CaSO_4$: Dy-teflon discs built into the badge, after moving the drawer. The heating programmer consists of the preheat, read, anneal and cool cycles. During the read cycle, the light output from the phosphor disc is measured by a small low noise PM tube. The PM tube output current is converted to pulse rate and fed into a 6 digit Nixie display thereby enabling dose measurements over a wide range. An autoranging count rate meter provides the glow curve output for external recording. The EHT to the PM tube has a long term stability of better than ±0.01%. Panel meter displays are provided for EHT, PM tube current and heater temperature. A programmer has been incorporated which furnishes output for automatic printing of badge data and dose value at the end of the cycle. The instrument is provided with facilities such as background compensation, calibration control for direct dose read-out, etc. Visual indicators are provided for dose selected (mR or R), over-range of dose, read-cycle and print. A stable light source using LED has been incorporated to check the stability of the system. The unit utilizes integrated circuits throughout for reliable performance. The instrument fulfils a long-standing need for large scale processing of TLD badges required for personnel monitoring. (auth)

29311 SENSITIVE Al_2O_3 THERMOLUMINESCENCE PHOSPHOR. Mehta, S. K.; Sen Gupta, S. (Bhabha Atomic Research Centre, Bombay, India). pp 580-590 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Thermoluminescence (TL) of gamma irradiated Al_2O_3 with prominent Na impurity has been studied. Glow peaks at 125°C, 175°C, 250°C, 325°C, 475°C and 625°C have been observed in this phosphor. Spectral emission of this TL is in the region 350 to 500 nm with a peak at 425 nm. The effect of pre-irradiation heat treatment up to 2000°C and of Na impurity concentration in the range 1 to 500 ppm on the TL of Al_2O_3 has been investigated. The main dosimetric peaks show correlation with Na impurity concentration. With appropriate heat treatment the TL intensity was enhanced by a factor of 10^5. This phosphor was five times more sensitive than TLD-100. The sensitized powder and sintered pellets prepared from it were used for dosimetry from 1 mr to 1 mega rad, using linearity in the 250° and 475°C peaks. (auth)

29312 PREPARATION OF SINGLE CRYSTALS OF MATERIALS FOR THERMOLUMINESCENCE STUDIES. Rao, S.M.D. (Bhabha Atomic Research Centre, Bombay, India). pp 591-605 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Difficulties encountered in preparing single crystals of thermoluminescent (TL) materials melting at high temperature and which decompose when heated in air are discussed. Restricted choice of refractories for melting materials like fluorides, which react with the surroundings, are described. Design details of a furnace which can be used for growing crystals at temperatures of the order of 2000°C by Bridgman method are given. A cage type graphite heater prepared in the laboratory is used for alternating these high temperatures. Graphite crucibles are used for growing single crystals in single units and batches. Advantages of graphite over other materials in making the heater and crucibles are discussed. TL glow curves and emission spectra of LiF (Mg, Ti) and CaF_2 RE grown in this furnace are presented. (auth)

29313 SPURIOUS THERMOLUMINESCENCE IN TL PHOSPHORS. Kathuria, S. P.; Sunta, C. M.; Sasidharan, R.; Jain, V. K. (Bhabha Atomic Research Centre, Bombay). pp 690-698 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The presence of tribo- or spurious thermoluminescence in TL materials is well known. Somewhat detailed investigations of this phenomenon in ceramics are available in literature. However, studies of spurious thermoluminescence in TLD phosphors are not many. The results of investigation on spurious thermoluminescence in six commonly studied thermoluminescent materials viz. LiF, natural CaF_2, CaF_2 : Dy, $Li_2B_4O_7$: Mn, $CaSO_4$: Tm and quartz are presented and an explanation for the phenomenon is offered on the basis of these observations. (auth)

29314 TRACE DETECTORS WITH AN EXTENDED RANGE OF MEASUREMENTS. Roginets, L. P.; Yaroshevich, O. I.; Malykhin, A. P.; Zhuk, I. V. Sov. At. Energy (Engl. Transl.); 39: No. 1, 636-637(Jul 1975).

Translated from At. Energ.; 39: No. 1, 60-62(Jul 1975).

The range of measurable track densities on the surface of a solid track detector is two orders of magnitude or a little more, and is limited at low track densities by the deterioration of the counting statistics, and at high densities by the overlapping of tracks. In order to encompass a broader range for measuring neutron doses or nuclear fission densities people generally use a set of fissionable foils with various enrichments in contact with the detectors, or process the detectors by a stepwise chemical procedure. The possibility of broadening the range of measurements for one source, one detector, and one chemical processing was studied. To do this it is proposed to use a track detector with a thickness less than the maximum range of the fission fragments of the fissionable nuclei in the detector material. If the radiation dose is large and the tracks on the front side of the detector facing the source overlap, the required value is found by determining the track density on the back face, where it is very much lower, and multiplying it by the attenuation factor K, numerically equal to the ratio of the track density on the front of the detector T' to that on the back T''. The value of K does not depend on the neutron flux density or the irradiation time, and can be measured beforehand with good accuracy for a given source and detector and a given processing procedure. (WHK)

29315 ON THE ACCURACY OF γ ACCIDENT DOSEMETERS. Kraus, W.; Will, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Kunze, R.; Hecker, O. (Amt fuer Standardisierung, Messwesen und Warenpruefung, Berlin (German Democratic Republic). Bereich Messwesen). Kernenergie; 18: No. 8, 252-253(1975). (In German)

Checks of the accuracy of γ accident dosemeters used in CMEA countries showed that the LiF thermoluminescent dosimeters and the glass photcluminescent dosemeters applied in the GDR can be evaluated with errors of less than ±10%. Detectors used in routine personnel dosimetry such as film and LiF/teflon disks also gave a satisfactory accuracy in estimating accident doses.

29316 METHODS AND APPARATUS FOR THE METROLOGICAL GUARANTEE OF THE EQUIVALENT FAST NEUTRON DOSE. Bregadze, Yu. I.; Maslyaev, P. F. Meas. Tech. (USSR) (Engl. Transl.); 18: No. 8, 1234-1238(Aug 1975).

Translated from Izmer. Tekh.; 18: No. 8, 80-82(Aug 1975).

A combination of equipment intended for the metrological provision of measurements of the equivalent fast neutron dose is briefly described. In the facility for measuring the intensity of the tissue dose of fast neutrons, there is an assembly of 10 homogeneous ionization chambers, made of different materials, a power supply for the chambers, current strength meter and a system for filling the chambers with gases. This facility, designed for certification as a working standard of the absorbed dose of neutron radiation, over the range of dose intensities from 10^{-7} to 10^{-2} rad/sec (10^{-9} to 10^{-4} W/kg) has relative random and systematic measurement errors not exceeding 4 and 3.5% respectively, with a confidence coefficient of 0.95. (WHK)

29317 ELECTROMETER FOR CLINICAL DOSIMETRY. Allewaert, J. (Ghent Rijksuniversiteit (Belgium). Kliniek voor Radiotherapie en Kerngeneeskunde). Rayonnem. Ionis. Tech. Mes. Prot.; No. 3, 107-112(Jul 1975). (In French)

From 9th congress on the control of ionizing radiation; Grenoble, France (15 Apr 1975).

A battery-supplied electrometer is described, suitable for most of the measurements necessary in a radiotherapy centre. Ionization chambers of different makes can be used.

29318 HEAT-STIMULATED EXOELECTRONIC EMISSION (EETS). Application to Dosimetry. Petel, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Rayonnem. Ionis. Tech. Mes. Prot.; No. 3, 123-132(Jul 1975). (In French)

From 9th congress on the control of ionizing radiation; Grenoble, France (15 Apr 1975).

The development of a reading system for exoelectron detection involves certain difficulties. Four years of research have led to the design of operational measurement chains which are used for EETS applications to radiation dosimetry. Several specialized laboratories, mostly European, are studying beryllium oxide, a very interesting basic material. A special study

was devoted to the dosimetric properties of α phase alumina. The results obtained are given and discussed. In addition, a correspondence was observed between radiothermoluminescence and EETS. Results obtained with alumina and lithium fluoride are presented.

29319 SAMPLE TRANSFER DEVICE FOR THERMOLUMINESCENT DOSEMETERS. Marchal, P.; Portal, G.; Recule, A. (to CEA, 75 - Paris (France)). French Patent 2,235,375/A/. 29 Jun 1973. 7p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France)

The present invention relates to thermoluminescent dosemeters designed for replacing the photographic emulsion devices as radiation dosimeters. The present device comprises a drawer, or sliding panel provided with sockets adapted to receive samples in point contact in the plane of said drawer and a guide member for receiving the drawer and restricting the movements of the samples in the direction normal to said plane. This can be applied to the transfer devices used for working out the information provided by thermoluminescent dosimeters in reading instruments.

29320 COMPARISONS OF RADIATION DOSIMETRY BETWEEN LOUVAIN (BELGIUM) AND EDINBURGH (UK). Law, J. (Western General Hospital, Edinburgh (UK)); Prignot, M.; Wambersie, A. (Louvain Univ. (Belgium). Inst. du Cancer). J. Radiol., Electrol., Med. Nucl.; 56: No. 5, 419-421(May 1975).

A comparison of radiation dosimetry performed between Edinburgh and Louvain using the $FeSO_4$ system, was reported. The procedure adopted provided comparisons both of solution response and of spectrophotometer calibration, and also provided a comparison of ionization dosimetry and irradiation techniques at the two centres. Therefore dosimeter solutions were prepared in both centres, $FeSO_4$ samples were irradiated either in Edinburgh (4 MV X-rays) or in Louvain (^{60}Co), finally optical densities were measured using the spectrophotometer of both centers. An agreement between the two centers of better than 1% was observed, both for ionization dosimetry and irradiation techniques and for spectrophotometer calibration. The ratio of Louvain to Edinburgh solution response was found close to 1 (0.998 ± 0.004). However, a previous comparison showed a discrepancy of 2% which illustrates the care needed in checking the purity of the solution components and mainly of the distilled water.

29321 HIGH RADIATION DOSE DOSIMETRY SYSTEMS. Lambert, K. P.; Schonbacher, H.; van de Voorde, M. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 153-160 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

Data concerning the principal Megarad dosimeters have been analyzed in a search for the most suitable dosimeters for material damage studies in a high-energy particle accelerator environment. This has resulted in the adoption of the phosphate glass radiophotoluminescent (RPL) system for routine dosimetry.

29322 THERMOLUMINESCENCE OF LITHIUM BORATE ACTIVATED BY MANGANESE OR OTHER ELEMENTS. Sekine, T. (Government Chemical Industrial Research Inst., Tokyo (Japan)). Denki Kagaku; 42: No. 8, 404-407(Aug 1974).

The present investigation has been carried out to examine preparation conditions which have an effect upon the thermoluminescence of manganese-activated lithium tetraborate, and to match the spectral distribution of thermoluminescence, when activated with elements other than manganese, to that of the highest sensitivity of a photomultiplier. In this work the samples were prepared by the solid-state reaction between lithium carbonate and ammonium tetraborate. The mixing ratio of matrix, firing condition and activator concentration were examined as preparation factors affecting thermoluminescence characteristics. It was found that thermoluminescent intensity depends on a small deviation around stoichiometric ratio of the matrix, and that as the firing temperature was raised up to the melting point the higher intensity was obtained, while rapid cooling gave a good result. Activation with copper, silver and gallium gave fair luminescent characteristics. (auth)

29323 THERMOELASTIC DOSIMETRY OF CHARGED-PARTICLE BEAMS. Volovik, V.D.; Ivanov, S.I. (A. M. Gor'kii Khar'kov State University). Sov. Phys.-Tech. Phys. 20: No. 8, 1140-1140 (Aug 1975).

In a study of the elastic vibrations excited by pulsed proton and electron beams in aluminum and a piezoelectric ceramic it has been found that the excitation can be described by thermoelastic theory for frequencies up to 1.2 MHz. Applications of the thermoelastic excitation of ultrasonic waves to the study of certain properties of condensed media are pointed out. Relations are found between the time characteristics of the acoustic signals and the diameter of the collimated particle beam.

29324 STUDY ON THE NEUTRON DOSIMETRY WITH LiF THERMOLUMINESCENT DOSIMETERS. Yoo, Y. S.; Kim, P. S.; Moon, P. S. (Korea Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 7: No. 3, 191-198(Sep 1975).

A study was made on the neutron dosimetry in a mixed gamma-neutron field with LiF thermoluminescent dosimeter. In order to estimate the neutron dose in a mixed field, ^6LiF and ^7LiF dosimeters were used for fast and thermal neutron doses. The over-all conversion factors for the effects of dosimeter positions were derived for personnel monitoring and the glow curves of the LiF dosimeters for neutron and gamma-ray doses were also analyzed.

29325 INSTALLATION FOR ABSOLUTE MEASUREMENTS OF THE ABSORBED DOSE OF PHOTON RADIATION IN GRAPHITE. Sebekin, A. P.; Skotnikov, V. V.; Fominykh, V. I.; Tsvetkov, I. I.; Yudin, M. F. (All-Union Scientific-Research Inst. of Metrology, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1063-1065(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 51-53(1975).

A differential graphite calorimeter for absolute measurement of the absorbed dose of photon radiation in the range of boundary energies of the bremsstrahlung spectrum 0.8 to 8 pJ (5-50 MeV) is described. The error in the indicated energy and dosage ranges is <2.5%.

29326 LiF DOSIMETRY BASED ON RADIOPHOTOLUMINESCENCE (RPL). Levita, M. (Soreq Nuclear Research Centre, Yavne, Israel); Schlesinger, T.; Friedland, S. S. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 667-674(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A dosimetric method based on the radiophotoluminescence (RPL) of single crystals and extruded pellets of LiF has been developed. Thermoluminescence dosimetry (TLD) with LiF is currently used in clinical applications because of its tissue equivalency response and its physical characteristics; e.g. small size, non-sensitivity to humidity, flexibility in geometrical form, etc. Disadvantages of TLD are: (a) it saturates at a dose level beginning at several hundred R and (b) the readout process is destructive. In many clinical applications a dosimeter is needed that can operate at higher doses. An RPL method using LiF was developed which can be used at higher doses and maintains tissue equivalency response. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 29092, 30496, 31637, 31904, and 32315.

29327 (ILL-RA-1974) ILL ANNUAL REPORT 1974. (Institut Max von Laue-Paul Langevin, 38-Grenoble (France)). 1974. 117p. (In French, English). INIS.

This annual report provides a general view of the activities of the different sections of the ILL. In 1974, twenty-two different neutron spectrometers with different characteristics were available on a regular basis. Moreover, a number of special neutron sources were employed for on-line experiments. The major effort was devoted to an increase in experimental systems and to the development of new measurement techniques.

29328 (INR-1446/IA/PL/A) TIMING WITH GERMANIUM DETECTORS. Szymczyk, W.; Karwowski, H. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 36p. INIS.

A system for measurements of nuclear lifetimes using large volume Ge/Li/ coaxial detectors is described. The extensive study of the pulse shape selection method has been done, and the improvement of about 40% of the prompt curve parameters has been obtained by means of this method. The described system can be used for nuclear levels lifetime measurements from 4.5 ns for γ-rays energy 100 keV to 0.5 ns for 1.5 MeV. (auth)

29329 (ORNL-tr-4077) SCINTILLATION GAMMA SPECTROMETRY WITH A STILBENE CRYSTAL. Kolevatov, Yu. I.; Kukhtevich, V. I.; Goryachev, I. V. Translated by M. Gerrard from Vopr. Dozim. Zashch. Izluch., Mosk. Inzh. Fiz. Inst., Sb. Statei; No. 10, 131-137(1969). 7p. Dep. NTIS $3.50.

A method of converting apparatus for amplitude dispersion to energy dispersion of gamma quanta measured with a single stilbene crystal gamma spectrometer is described. One of the main advantages of this spectrometer is the possibility of practically simultaneous measurement by one detector of gamma and neutron spectra. (WHK)

29330 HIGH RESOLUTION TIME SPECTROSCOPY IN NUCLEAR PHYSICS. Stuckenberg, H. J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Kerntechnik; 17: No. 5, 225-235(May 1975). (In German, English)

17 figs.; 2 tabs.; 8 refs.

Time spectroscopy of low energy and high energy particles and of γ quanta is carried out with digital circuits with a resolving power in the pico- or nanosecond range. The pulse signals generated by particles detectors are burdened with time errors, discussed on the example of scintillation counters. Before the time relationships between these pulse signals from two or more detectors are measured in coincidence circuits or in time/pulse height converters, they are shaped into standard pulses. This paper discusses various pulse-shaping and triggering methods and presents measured time resolution curves. (DE)

29331 NEUTRON SPECTRA UNFOLDING FROM THE RESULTS OF MEASUREMENTS WITH A MULTISPHERE SPECTROMETER. Semenov, V. P.; Trykov, L. A.; Tyufyakov, N. D. Prikl. Yad. Spektrosk.; No. 5, 168-177(1975). (In Russian)

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

A comparative evaluation is made of several methods for evaluation of the data from multisphere spectrometers for the unfolding of thermal neutron spectra. (JSR)

29332 EVALUATION OF THE EFFICIENCY OF SEVERAL METHODS OF NEUTRON SPECTRA UNFOLDING APPLIED TO MULTISPHERE SPECTROMETERS. Semenov, V. P.; Trykov, L. A.; Tyufyakov, N. D. Prikl. Yad. Spektrosk.; No. 5, 178-182(1975). (In Russian)

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The methods reviewed in the previous paper are analyzed for their efficiency in spectra unfolding from the results of measurements with a multisphere spectrometer. Numerical studies on the unfolding of a series of test spectra are reported graphically. In all cases it was confirmed that in all the cases examined the errors of integrals with respect to the spectra unfolding do not exceed the errors of the original data. (JSR)

29333 OPTIMIZATION OF THE SPECTROMETRIC CHARACTERISTICS OF A SCINTILLATOR–PHOTODIODE SYSTEM. Stolyarova, E. L.; Drygin, V. N.; Uimanov, V. A. Prikl. Yad. Spektrosk.; No. 5, 111-116(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

A study was made to improve the quality of a spectrometer with a scintillator–photodiode system by coating the photodiode. Tests showed that coating the surface of the photodiode with a thin layer of resin provides a reliable protection of the Au contact without giving any additional noise. The detector, consisting of a CsI(Tl) crystal and a commercial Au–Si surface-barrier photodiode, gives a satisfactory resolution of α spectra not inferior to the resolution of the scintillation spectrometer with a photomultiplier. The system can be used in problems requiring the registration of particles of one kind in a background of other particles and γ radiation. (JSR)

29334 ALPHA SPECTROMETRIC ANALYSIS OF SPECIAL LOW-ACTIVITY MATERIAL. Yakunin, M. I. Prikl. Yad. Spektrosk.; No. 5, 117-129(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The basic characteristics of the spectrometer for the α spectroscopy of materials with specific activity below 10^{-9} Ci/g, even to 10^{-14}, are described. The optimum conditions for the measurements and for suppression of the background are determined. The design of the ionization chamber developed for work with very low activity material and the preparation of large-area sources for use in the spectrometer are described. Some examples are given of results obtained. (JSR)

29335 CURRENT AMPLIFIER FOR NEUTRON SPECTROMETER. Eldashev, V. V.; Trykov, L. A.; Tyufyakov, N. D. Prikl. Yad. Spektrosk.; No. 5, 130-132(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

A transistorized amplifier, simple in construction and tuning, for an organic scintillation neutron spectrometer is described. Its circuit is given and its basic characteristics are described. (JSR)

29336 STABILIZATION AT THREE POINTS OF A HIGH RESOLUTION $\pi\sqrt{2}$ BETA SPECTROMETER. Grybinyk, A. I.; Lyutyi, I. N. Prikl. Yad. Spektrosk.; No. 5, 133-137(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

An improved system of stabilization of the magnetic field is described in which a third nutation NMR detector controls the current of the second shim. It is placed at the point where the optimum value of the field is equal to the arithmetic mean value of the field of two stabilized points. A structural diagram is given of the system. (JSR)

29337 REGISTRATION OF THE ENERGY SPECTRA OF POSITRONS BY MEANS OF SEMICONDUCTOR DETECTOR. Arifov, U. A.; Arifov, P. U.; Grupper, A. R.; Il'yasov, A. S.; Kireev, V. A.; Musaev, T. Z.; Yafasov, A. Ya. Prikl. Yad. Spektrosk.; No. 5, 163-167(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

An experimental installation is described for studying the energy spectra of positrons. With this installation it is possible to sharply reduce the background and the registration of inelastically reflected positrons. The positrons were measured with a Si(Li) semiconductor detector, spectrometric tracks, and a multichannel amplitude analyzer. The results obtained in the measurement of the spectrum of a nonmonoenergetic positron source, with and without Al filters, and of the spectrum of a monoenergetic positron source are given. (JSR)

29338 OPTIMUM APPROXIMATION FORMS OF LINES OF A SEMICONDUCTOR GAMMA SPECTROMETER. Volkov, N. G.; Fedotov, S. N. Prikl. Yad. Spektrosk.; No. 5, 58-59(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

An approximation method was developed for calculating the actual mechanism of the distortion of the line forms caused by the superposition of pulses in the spectrometer signals. (JSR)

29339 MEASUREMENT OF THE ANGULAR DISTRIBUTION OF NUCLEAR REACTION PRODUCTS BY MEANS OF FLAT DETECTORS. Kuritsyn, V. N. Prikl. Yad. Spektrosk.; No. 5, 100-105(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

A method is proposed for the measurement of the angular distributions which guarantees a maximum luminosity of the spectrometer in a counter with high angular resolving capacity. The method is based on the selection of the geometry of the flat detector. The geometry is calculated for three cases. (JSR)

29340 RESOLUTION FUNCTION OF A TRIAXIAL NEUTRON SPECTROMETER. Bobrovskii, V. I.; Goshchitskii, B. N.; Mirmel'shtein, A. V.; Mikhailov, Yu. N. (Inst. of Metal Physics, Sverdlovsk, USSR). Sov. Phys.–Crystallogr. (Engl. Transl.); 20: No. 3, 308-311(1975).

Translated from Kristallografiya; 20: No. 3, 504-510(1975).

The kinematic theory of elastic coherent neutron scattering is used with a continuous-mosaic model to derive an expression for the resolution of a spectrometer with ordinary and double monochromators. The sequential derivation enables one to avoid additional normalizing procedures required by earlier studies. (auth)

29341 GAMMA-RAY SPECTROMETRIC SET-UP AT NGRI FOR ANALYSIS OF U,Th AND K IN ROCKS. Rao, U. R. (National Geophysical Research Inst., Hyderabad (India)). Geophys. Res. Bull.; 12: No. 2, 91-101(Apr 1974).

A γ-ray spectrometer with a NaI (Tl) detector and a single channel analyzer has been set up for analysis of rocks for radioelements uranium, thorium (at ppM level) and potassium. Constructional details, operational procedures and method of analysis of the output from the spectrometer are given. Errors, limits of detectability, sample counting time, reproducibility and an inter-laboratory comparison of results are discussed. Further plans of work in this direction are outlined.

29342 ANALYSIS OF COSMIC RAY SPECTROMETER DATA BY THE METHOD OF LEAST SQUARES AND m.d.m. OF THE SPECTROGRAPH. Basu, P. S.; Nandi, B. C. (Regional Engineering Coll., Durgapur (India). Dept. of Physics). Proc. Indian Acad. Sci., Sect. A; 81: No. 5, 204-214(May 1975).

To calculate the momentum of a charged particle a least square fit method of the particle trajectory in any type of cosmic ray spectrometer is discussed. An expression for the maximum detectable momentum (m.d.m.) of the spectrometer has been derived and compared with the expressions obtained by other workers.

29343 DISTRIBUTION OF SHALE IN SANDSTONES AND ITS EFFECT UPON POROSITY. Thomas, E. C. (Shell Oil Co., New Orleans); Stieber, S. J. pp T.1-15 of Transactions of the SPWLA Sixteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts Inc. (1975).

From 16th annual logging symposium; New Orleans, Louisiana, USA (4 Jun 1975). See CONF-750643-.

A shale volume parameter derived from the response of the gamma ray log in shaly sands is often used to correct the responses of other logs for the effects of the shale. The correlation of a gamma ray parameter to shale volume is usually presented as one direct relationship. However, because the shale can be distributed through the sand in different ways, such as laminated, dispersed, structural, or any combination of these, one may expect varying gamma ray responses dependent upon geometry. It is shown that each of these configurations can involve a different response from the gamma ray and this variable response can be used to determine the shale configuration. A gamma ray parameter vs. porosity crossplot can then be used to determine shale configuration, sand fraction, and sand porosity; the derived equations can be used for implicit solution when processing digital log data. These configurational data can be combined with electric log parameters to determine the oil saturation of the net sand. These log derived parameters are herein verified by direct comparison to rubber sleeve core data. (auth)

29344 COMPARATIVE CHARACTERISTICS OF NaI(Tl) AND CsI(Tl) DETECTORS. Sobornov, O. P.; Shcheglov, O. P. Sov. At. Energy (Engl. Transl.); 39: No. 1, 640-642(Jul 1975).

Translated from At. Energ.; 39: No. 1, 63-65(Jul 1975).

The temperature dependence of the light output, photoefficiencies, intrinsic background noise, and other spectrometric parameters of NaI(Tl) and CsI(Tl) detectors are reported. (WHK)

29345 MONOCRYSTALLINE FILMS OF GaAs AS SPECTRAL DETECTORS OF X-RAYS AND SOFT γ-RADIATION. Zaletin, V. M.; Protasov, I. I.; Matveev, O. A.; Skorokhodov, P. I.; Khusainov, A. Kh. Sov. At. Energy (Engl. Transl.); 39: No. 1, 646-648(Jul 1975).

Translated from At. Energ.; 39: No. 1, 68-69(Jul 1975).

The crystal growth of pure monocrystalline layers of gallium arsenide is described, and the properties of detectors made from these films are discussed. (WHK)

29346 GAMMA-RAY SPECTROMETRY DATA COLLECTION AND REDUCTION BY SIMPLE COMPUTING SYSTEMS. Op de Beeck, J. (Univ., Ghent). At. Energy Rev.; 13: No. 4, 743-805 (Dec 1975).

The review summarizes the present state of the involvement of relatively small computing devices in the collection and processing of gamma-ray spectrum data. An economic and utilitarian point of view has been chosen with regard to data collection in order to arrive at practically valuable conclusions in terms of feasibility of possible configurations with respect to their eventual application. A unified point of view has been adopted with regard to data processing by developing an information theoretical approach on a more or less intuitive level in an attempt to remove the largest part of the virtual disparity between the several processing methods described in the literature. A synoptical introduction to the most important mathematical methods has been incorporated, together with a detailed theoretical description of the concept gamma-ray spectrum. In accordance with modern requirements, the discussions are mainly oriented towards high-resolution semiconductor detector-type spectra. The critical evaluation of the processing methods reviewed is done with respect to a set of predefined criteria. Smoothing, peak detection, peak intensity determination, overlapping peak resolving and detection and upper limits are discussed in great detail. A preferred spectrum analysis method combining powerful data reduction properties with extreme simplicity and speed of operation is suggested. The general discussion is heavily oriented towards activation analysis application, but other disciplines making use of gamma-ray spectrometry will find the material presented equally useful. Final conclusions are given pointing to future developments and shifting their center of gravity towards improving the quality of the measurements rather than expanding the use of tedious and sophisticated mathematical techniques requiring the limits of available computational power.

29347 TWO-CRYSTAL X-RAY SPECTROMETER WITH CONGRUENT ROTATION AXES. Koval'chuk, M. V.; Kov'ev, E. K.; Mirenskii, A. V.; Shilin, Yu. N. (Inst. of Crystallography, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1259-1261(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 203-205(1975).

The construction of a two-crystal x-ray spectrometer based on congruence of the rotation axes of the monochromator and analyzer (investigated) crystals is described. The principle by which the axes are made congruent permits the range of diffraction angles to be expanded to ~85° along with the range of wavelengths of the investigated radiation; it also permits minimization of the alignment procedures when the transition is made to new reflection orders, and, most important, allows precision determination of the angular position of the recorded curves to be carried out in parallel with measurement of the diffractional reflection curves (this, in turn, provides the possibility of determining the relative variation of the crystal-lattice parameter).

29348 COUNTERS AND TIMERS OF THE SUMMA SYSTEM OF UNITIZED MODULES FOR MULTICHANNEL ANALYSIS. Bushnin, Yu. B.; Dunaitsev, A. F.; Sen'ko, V. A.; Sytin, A. N. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1073-1074(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 58-59(1975).

Binary scaling devices and circuits which generate time intervals are described. The modules of the system of unitized electronic equipment are implemented in the new Soviet instrument-design standard "Vektor" and are designed for physics experimental installations which are connected "on-line" with an electronic computer (e. c.).

29349 CONTROL BLOCKS OF THE SUMMA SYSTEM OF UNITIZED MODULES FOR MULTICHANNEL ANALYSIS. Bushnin, Yu. B.; Denisenko, A. A.; Dunaitsev, A. F.; Rybakov, V. G. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1071-1072(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 57-58(1975).

The control blocks of the "SUMMA" system of unitized modules for multichannel analysis are described; the system is used in the experimental physics installations of the Institute of High-Energy Physics for operation on-line with an electronic computer (e.c.). The blocks allow control of several crates of electronic equipment (up to seven) according to a program from the internal program blocks or from the e.c. to be assured. The organization of the control is similar to the organization of the CAMAC electronic system. Examples of communication between the system and an NR2100 electronic computer are presented.

29350 ANALOG-DIGITAL CONVERTER AND INTEGRATING AMPLIFIER. Aul'chenko, V. M.; Korshunov, Yu. V.; Usov, Yu. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1098-1100(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 77-79(1975).

An analog-digital converter (a.d.c.) based on 1024 working channels and an integrating amplifier with linear gates at the input are described which are used with scintillation counters. The sensitivity of the a.d.c. is 10 mV/channel for an integral nonlinearity ≤0.5%; with the amplifier it is 0.1 pC/channel, and the maximum input loading is 2.5 MHz.

29351 CORRECTION OF AMPLITUDE SPECTRA WHICH HAVE BEEN DISTORTED AS A CONSEQUENCE OF PULSE SUPERPOSITION. Volkov, N. G.; Fedotov, S. N. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1089-1091(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 70-72(1975).

A procedure is expounded for correcting spectra that have been distorted due to the superposition of pulses in the spectrometer path. The method is based on solving an integral equation which relates the distorted spectrum to the true spectrum and the distribution of the "zero line." The procedure is applicable for an arbitrary pulse shape at the spectrometer output and an arbitrary form of the spectra. A comparison is made between the experimental spectra and their corresponding calculated spectra.

29352 PRINCIPAL CHARACTERISTICS AND POWER SUPPLY OF THE SUMMA SYSTEM OF UNITIZED MULTICHANNEL-ANALYSIS MODULES. Alferova, O. I.; Bushnin, Yu. B.; Denisenko, A. A.; Dunaitsev, A. F.; Leont'ev, V. M.; Sen'ko, V. A.; Sytin, A. N. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1069-1070(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 56-57(1975).

The principal electrical and mechanical characteristics of a system of electronic modules used in physics experiments on the accelerator at the Institute of High-Energy Physics are presented. A description is given of the system power supply which consists of three types of changeable blocks. It allows stabilized output voltages of ±6, ±12, ±24 V, and an unstable output voltage +200 V to be obtained. The maximum output power of the source is 300 W, and the accuracy of the voltage stabilization is at worst 0.5%. The power supply provides for disconnection from the line when the supply voltages deviate from the nominal values.

29353 DOUBLE IONIZATION CHAMBER FOR STUDYING FISSION-FRAGMENT SPECTRA. Basova, B. G.; Zakharova, V. P.; Korostylev, V. A.; Nefedov, V. N.; Rabinovich, A. D.; Ryazanov, D. K. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1056-1059(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 46-49(1975).

Using the example of measurement of the mass and energy characteristics of coincident fragments produced by spontaneous

fission of ^{252}Cf and by fission of ^{235}U by thermal neutrons, the possibilities of a double ionization chamber are discussed. A comparison is made with similar data obtained by means of silicon semiconductor detectors. The mass and energy resolutions of the ionization chamber are estimated.

29354 MEASUREMENT OF THE LINEAR POLARIZATION OF A GAMMA BEAM BY SPARK CHAMBERS ON-LINE WITH AN ELECTRONIC COMPUTER. Anan'in, P. S.; Goryachkin, V. G.; Kalinin, B. N.; Kuznetsov, V. M.; Tarasov, V. M. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1029-1031(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 25-27(1975).

The degree of linear polarization of the coherent bremsstrahlung beam of the Tomsk synchrontron was determined experimentally by analyzing the height distribution of electron–positron pairs in spark chambers situated in the paired-magnetic-spectrometer channel. The chambers operated on-line with an "Elektronika 100" electronic computer. The degree of polarization of the beam of γ quanta having an energy 270 MeV is equal to 0.42 ± 0.08.

29355 BUFFER ANALOG MEMORY BLOCK. Cherkasov, A. S.; Borzhkovskii, V. F.; Vlosov, V. G.; Grishaev, I. A.; Zalyubovskii, I. I.; Zagnoiko, N. K.; Frolov, A. I. (Kharkov State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1077-1080 (1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 60-63(1975).

A simple and economical buffer analog memory device is described which is designed for parallel writing of analog signals (positive polarity, amplitude up to 10 V, and duration ≥ 0.1 μsec) from ten or more channels and storage of the signals during intervals ranging from several tens of microseconds to several tens of milliseconds. The common load of the readout circuits of all of the channels is a short-circuited delay line which shapes a sequence of bipolar pulses for interrogating the memory of the channels (amplitude up to 10 V, duration 2 μsec). The partitioning of the memory of the pulse-amplitude analyzer or of the electronic computer (e.c.) into ten or more subgroups is achieved in the device by adding a stable pedestal to the input pulses and narrowing the amplitude range of the pulses to a value equal to the difference between the amplitudes of the pedestals of adjacent channels.

29356 PROTON RECOIL SCINTILLATION TECHNIQUE FOR ESTIMATING NEUTRON ENERGY SPECTRA. Sarkar, P. K.; Kirthi, K. N.; Ganguly, A. K. (Bhabha Atomic Research Center, Bombay). Nucl. Technol.; 28: No. 2, 270-281(Feb 1976).

The proton recoil technique using plastic scintillators is employed to measure fast-neutron spectra. Associated gamma-ray background is eliminated by using various thicknesses of thin scintillators. The method, based on different ranges of electrons and protons in the detector material, is shown to be useful for measuring neutron spectra over an extended energy region. Four scintillator thicknesses are chosen to cover the neutron energy from 1 to 18 MeV, based on practically 100 percent transmission of Compton-edge electrons. The pulse-height spectra from different detectors are mixed to give a pulse-height spectrum of the "combined" detector. A general purpose unfolding code is developed to unfold the combined pulse-height spectrum using a combined response matrix that results from the mixing of the calculated (Monte Carlo) response functions for the individual detectors. The neutron spectra of different (alpha,n) sources and of ^{252}Cf spontaneous fission are measured and compared with published data. The technique developed, although used only for a neutron energy up to 14 MeV, can be applied in practice to higher energies.

29357 IAEA EXPERIENCE IN THE DEVELOPMENT AND USE OF CdTe GAMMA SPECTROMETRIC SYSTEMS FOR SAFEGUARDS APPLICATION. de Carolis, M.; Dragnev, T.; Waligura, A. (International Atomic Energy Agency, Vienna). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 70-74(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The principal non-destructive assay systems used by the Agency in safeguards verification activities are passive techniques, particularly those which use signatures of gamma ray. The reason is that passive techniques are adaptable to the portable equipment of the international inspector. Further development and miniaturization of the portable equipment for nuclear material assay measurements depend strongly on the availability of semi-conductor gamma spectrometric detectors with significantly better resolving power than that of scintillation detectors and which can operate at room temperature. One of the most promising materials for such detectors is CdTe. Recent IAEA experience in the development and use of new semi-conductor spectrometric systems (mainly with CdTe detectors of different origins—USA, France, Czechoslovakia) and their use for nuclear material assay measurements are summarized. (auth)

29358 Fe-DOPED HIGH PURITY GaAs AS A ROOM TEMPERATURE GAMMA-RAY SPECTROMETRIC DETECTOR. Kobayashi, T.; Kura, I.; Hojo, A.; Sugita, T. (Tokyo Shibaura Electric Co.). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 97-101(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Fe-doped high purity GaAs crystals have been grown using a vertical-type liquid-phase epitaxial technique and have been studied as room temperature gamma-ray spectrometric detectors for nuclear fuel safeguards. To improve the detector gamma-ray counting efficiency, a double-epitaxial-layer detector was studied. (auth)

29359 PRELIMINARY STUDIES ON MERCURIC IODIDE SOFT-GAMMA-RAY DETECTOR. Chung, M. K.; Cho, S. W. (Korean Atomic Energy Research Inst., Seoul). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 112-116(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Tetragonal mercuric iodide single crystals were grown and applied to the fabrication of soft-gamma-ray detectors with high detection efficiencies and moderate energy resolutions. The studies included: (1) the dependency of single crystals grown by various techniques such as solution growth including recrystallization of the vapor transport grown crystal, vapor transport growth and temperature oscillation growth techniques on detector characteristics, (2) polarization effects, (3) electrical contacts problem, (4) fast-neutron-induced radiation damage and (5) linearity between pulse heights and energies. The detectors with various thicknesses from approximately 50 to 1000 microns were applied to x-ray fluorescence analysis; they proved to be a very promising tool in this field. (auth)

29360 LARGE AREA REACH-THROUGH AVALANCHE DIODES FOR X-RAY SPECTROSCOPY. Webb, P. P.; McIntyre, R. J. (RCA Ltd., Ste. Anne de Bellevue, Quebec). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 138-144(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Large area reach-through avalanche diodes have been studied for use in room temperature X-ray spectroscopy applications. Gains in the range 10-80 have been measured, for diodes of area 12 and 25 mm^2. Resolutions down to about 600 eV FWHM have been obtained for 5.9 keV X-rays. Various factors limiting resolution are discussed. The useful energy range is approximately 1.5–20 keV. (auth)

29361 SPECTROMETER PERFORMANCE OF N-TYPE CADMIUM TELLURIDE X- AND gamma-RAY DETECTORS. Dabrowski, A. J. (Inst. of Nuclear Research, Swierk, Poland); Chwaszczewska, J.; Iwanczyk, J.; Triboulet, R.; Marfaing, Y. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 171-176(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Highly perfect n-type CdTe single crystals grown by the sealed-ingot-zone refining method have been used to fabricate semiconductor surface-barrier detectors for X- and low-energy gamma-ray analysis. An energy resolution of 2.0 keV (fwhm) and 1.5 keV (fwhm) was achieved for 59.5 keV gamma-rays from ^{241}Am and 5.9 keV characteristic K X-ray line from ^{55}Fe source, respectively. Spectra were measured at room temperature with low detector bias. The observed full energy peak of 59.5 keV gamma-rays has been compared with the theoretical peak calculated for a surface-barrier junction with fixed space charge, the trapping effects being taken into account. (auth)

29362 PSEUDO-GAUSSIAN TRANSFER FUNCTIONS WITH SUPERLATIVE BASELINE RECOVERY. Mosher, C. H. (Nuclear Equipment Corp., San Carlos, CA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 226-228(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The transfer function comprised of (2n +1) poles unit spaced in the omega direction on the line s equals -D in the s plane is analyzed in the time domain and shown to have the response F/sub n/(t) equals C/sub n/e/sup -DT/sin/sup 2n/(t/2), providing a clean pseudo-gaussian pulse. If D equals 1.5, the afterpulses are theoretically down by about a factor of 8×10^{-5} and are experimentally acceptable. Experimentally, such as analog signal processor (D equals 1.5, n equals 3, unit time equals 20 us.) shows excellent shift vs. input rate. (auth)

29363 NEW APPROACH TO TIMING: THE FAST–FAST SYSTEM. Hardy, W. H. II; Lynn, K. G. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 229-233(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A dual channel constant fraction timing discriminator incorporating multiple energy windows and coincidence logic has been developed. Incorporation of energy discrimination and fast coincidence logic into the timing channel has distinct advantages in terms of system simplicity, stability and data rates. A prototype applying the F^2 approach has been constructed and tested. The system gives a ^{60}Co FWHM of approximately 210 psec at a singles rate of greater than 7.5×10^3 sec^{-1} (approximately 1200 coincidences/sec).

29364 NEW CONSTANT FRACTION TIMING SYSTEM WITH IMPROVED TIME DERIVATION CHARACTERISTICS. Bedwell, M. O.; Paulus, T. J. (ORTEC, Inc., Oak Ridge, TN). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 234-243(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A constant fraction timing system having excellent time derivation properties over a wide dynamic range of signals is described. Leading edge walk is significantly reduced by arming the constant fraction zero-crossing circuit with a discriminator that is separate from the energy discriminator. Timing resolution with Ge(Li) detectors can be improved by the optional use of a slow risetime reject circuit, but only at the expense of reduced counting efficiency. This performance trade-off is described in detail. Extensive data are presented on the timing performance in gamma-gamma coincidence experiments. (auth)

29365 SEALED XENON GAS SCINTILLATION PROPORTIONAL COUNTER FOR X-RAY ASTRONOMY. Andresen, R. D.; Karlsson, L.; Taylor, B. G. (European Space Agency, Noordwijk, Netherlands). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 473-475 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A gas scintillation proportional counter operating without the conventional gas purification system, for use in instruments for X-ray astronomy, is under development. A parallel grid detector has been built employing ultra high vacuum technology, equipped with a caesium getter to maintain purity, filled with xenon at one atmosphere and sealed. The detector does not employ a wavelength shifter (the scintillation being in the UV region) and no attention was paid to optimising the light collection efficiency. The experimental results demonstrate that the output signal is in the form of a pulse-train, which offers unforeseen possibilities for direct digital energy measurements, involving high frequency pulse counting and pulse-train length discrimination for the vetoing of particles producing extended ionization trails. (auth)

29366 CRYSTAL X-RAY SPECTROSCOPY AND POLARIMETRY ON OSO-8. Mitchell, D.; Rochwarger, I.; Sackson, M.; Bischoff, G.; Bodine, O. (Columbia Univ., New York). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 480-486(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A satellite-borne, high-sensitivity crystal X-ray spectrometer and an X-ray polarimeter have been orbited in the OSO-8 spacecraft. In the quiet Sun or solar-flare mode, the spectrometer records a spectrum of solar X-rays from 1.4 to 8 keV every 10 s. In the stellar mode, the instrument measures the spectra from 2 to 8 keV of celestial X-ray sources. The focusing crystal X-ray polarimeter measures the polarization of X-ray emission at 2.6 and 5.2 keV from celestial sources. (auth)

29367 DETECTOR SYSTEM FOR IN SITU SPECTROMETRIC ANALYSIS OF ^{241}Am AND Pu IN SOIL. Kirby, J. A.; Anspaugh, L. R.; Phelps, P. L.; Armantrout, G. A.; Sawyer, D. (Univ. of California, Livermore). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 683-689(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

This system for quantitative analysis of Pu in soil via ^{241}Am has four 2.5-mm high-purity Ge detectors of 33 cm^2 total detecting surface area. These detectors are paralleled by gating circuitry to avoid the degradation of energy resolution associated with electronic output summing. In field tests the system was approximately three times as sensitive as a 70-cm^3 Ge(Li) detector and approximately an order of magnitude more sensitive than the FIDLER system. (auth)

29368 INVESTIGATION OF ^{222}Rn IN SUBSURFACE WATERS AS AN EARTHQUAKE PREDICTOR. Smith, A. R. (Univ. of California, Berkeley); Bowman, H. R.; Mosier, D. F.; Asaro, F.; Wollenberg, H. A.; King, C. Y. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 694-698(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Changes of ^{222}Rn content of well waters in seismically active regions may provide earthquake precursor signals, according to reports of recent Chinese and Russian work. A high-precision gamma-ray system for continuous monitoring of radon in wells and springs has been developed at the Lawrence Berkeley Laboratory, where monitoring began in April 1975, and has been extended to other sites including the San Andreas fault zone. (auth)

29369 IN SITU GAMMA-RAY MEASUREMENT USING Ge(Li) DETECTORS. Sakai, E.; Terada, H.; Katagiri, M. (Japan Atomic Energy Research Inst., Ibarakiken). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 726-733(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A portable 73 cm^3 closed-end coaxial Ge(Li) gamma-ray spectrometer was made and in-situ measurement of environmental gamma-rays has been carried out. The detector has 17.5 percent peak detection efficiency and 2.5 keV FWHM energy resolution for 1333 keV gamma-rays at a source-to-detector distance of 25 cm. The peak counting rate per unit flux of 662 keV gamma-rays was 3.62 cps/photon/cm^2 sec and FWHM was 2.1 keV. Peak counting rate dependence on incident direction of parallel beam of gamma-rays was measured to find correction factors for in-situ data analysis. From the in-situ measurements, the concentrations of ^{238}U, ^{232}Th, ^{40}K, and ^{137}Cs in the soil and their contributions to the total exposure rate at the detector were induced. These results are compared with those of low level Ge(Li) spectrometer measurement of soil samples and with those of in-situ measurement using a 3" x 3" NaI(Tl) detector spectrum-to-dose conversion operator method. Another Ge(Li) detector having a special lead shield was made to detect only gamma-rays from plumes. (auth)

29370 EVALUATION OF STANDARDIZED Ge(Li) GAMMA RAY DETECTORS FOR LOW LEVEL ENVIRONMENTAL MEASUREMENTS. Walford, G. V.; Cooper, J. A.; Keyser, R. M. (ORTEC, Inc., Oak Ridge, TN). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 734-742(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Counting sensitivity for standardized Ge(Li) detectors has been determined for a large number of detector-sample geometries and counting conditions. It has been found that relatively simple systems can satisfy a majority of applications, thereby resulting in a favorable cost-effective approach to environmental measurements. Recommendations are made for the improvement of significant counting parameters for specific applications, resulting in the maximum counting capability for a given detector system. (auth)

29371 ANALYTICAL REPRESENTATION OF THE RESPONSE OF THE NaI(Tl) DETECTOR FOR THE γ-RAY SPECTRUM ANALYSIS. Baba, H.; Sekine, T. (Japan Atomic Energy Research Inst., Tokai). J. Radioanal. Chem.; 29: No. 1, 109-119(1976).

An analytical function for describing the response function of γ-rays from the NaI(Tl) detector was constructed with the purpose of establishing the method of automatic γ-ray spectrum analysis. The response was found to be divided into six portions; the function of each portion joins smoothly to the one representing the adjacent part. Empirical equations for the parameters specifying the response function were found as functions of the γ-ray energy in relation to the detector dimension. The obtained response function was fitted to the observed spectrum by the least squares method. The calculated spectrum agreed well with the observed one. (auth)

High Energy Physics Instrumentation

29372 15 FOOT BUBBLE CHAMBER NEUTRINO PHYSICS. Huson, F. R. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). pp 357-383 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

Preliminary results from 15 foot bubble chamber neutrino experiment on hydrogen are presented, showing that the chamber parameters are being understood reasonably well. Raw multiplicity distributions are given for several neutrino energies. Among 274 events, approximately ⅓ have either gammas and/or vees, and about ¼ of these are vees. The average detection efficiency for external muon identifier plus chamber for neutral currents is about 75%.

29373 MODULES FOR SCINTILLATION HODOSCOPES OF THE SUMMA SYSTEM OF UNITIZED MODULES FOR MULTICHANNEL ANALYSIS. Bushnin, Yu. B.; Denisenko, A. A.; Dunaitsev, A. F.; Sen'ko, V. A. (Inst. of High-Energy Physics,

Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1075-1076(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 59-60(1975).

Modules of the unitized electronic equipment for the recording, analysis, and data output to an electronic computer (e.c.) are described; these modules are used in designing electronic systems for multichannel hodoscopic installations for the 70-GeV accelerator at the Institute of High-Energy Physics. The composition of the modules includes input registers, logical modules, a high-speed buffer memory module, and a nanosecond-pulse branches. The equipment is implemented in the new Soviet instrument-design standard "Vektor."

29374 OPERATIONAL MONITORING OF THE OPERATION OF OPTICAL SPARK CHAMBERS. Alizade, V. V.; Dem'yanov, A. V.; Khazins, D. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1037-1039(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 31-32(1975).

A procedure is described for registering the time at which the spark channel is formed according to the shape of the high-voltage pulse using nanosecond electronic circuitry. The use of this procedure allows continuous monitoring of the efficiency of an optical spark chamber and of the quality of the working gas in it. The signal which develops as a result of chamber breakdown may be used to isolate useful events.

29375 WIDE-GAP SPARK CHAMBERS FOR THE INVESTIGATION OF REVERSE ELECTROPRODUCTION OF PIONS. Alizade, V. V.; Dem'yanov, A. V.; Khazins, D. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1040-1042(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 33-35(1975).

Track spark chambers with a gap of 50 mm and dimensions 450 × 380 mm filled with Ne are described; the high-voltage pulse for these chambers is produced by Arkad'ev-Marx generators. It is shown that small additions of methane to Ne substantially improve the quality of the tracks. The memory time of the spark chambers is measured as a function of the amount of methane. The dependence of the efficiency of the spark chambers on the angle of inclination of the particle tracks is presented, and the causes of the reduction of track brightness with an increase in the angle are discussed.

29376 CHARACTERISTICS OF A WIDE-GAP SPARK CHAMBER WITH POLYETHYLENE PLATES IN THE WORKING VOLUME. Anan'in, P. S.; Glavanakov, I. V.; Stibunov, V. N. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1043-1045(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 35-37(1975).

The characteristics of a wide-gap spark chamber with polyethylene absorbers are presented. The dependences of the efficiency with which the particles are recorded by the chamber on the amplitude and on the time delay of the high-voltage pulse are measured. The accuracy with which the sparks are traced along the particle track and the dimensions of the sparks are determined when the chamber is filled with Ne.

29377 AUTOMATION FOR HANDLING FILMED DATA. Koshtoev, V. V.; Kulidzhanov, B. K.; Bondarenko, P. A.; Mandzhavidze, Z. Sh. (Inst. of Physics, Tbilisi, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1046-1048(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 37-39(1975).

An automaton is described for handling x-ray and other photographic film. The automaton performs stepped scanning of a rectangular sector of film having the dimensions ~410 × 500 μ. A scanning step is 16 ± 1 μ, and the distance between lines is 19 ± 1 μ. During the scanning process photometry of the film is performed with a stipulated step plus output of the measurement results onto punched tape.

29378 USE OF GaSe SEMICONDUCTOR DETECTORS FOR MONITORING HIGH ENERGY MUON BEAMS. Mancini, A. M.; Manfredotti, C.; Murri, R.; Rizzo, A.; Quirini, A.; Vasanelli, L. (Univ., Bari, Italy). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 189-197(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

GaSe semiconductor detectors have been successfully tested during one year for monitoring muon beams in the GeV range in the neutrino experiment at CERN. Their performances are comparable with those of commercial Si surface barrier detectors for this particular application. Crystal growth, detector fabrication and characterization are briefly described. Various advantages (cost, ruggedness, resistance to radiation damage, manufacturing simplicity, etc.) are discussed. (auth)

29379 DESIGN AND PERFORMANCE OF SIMPLE TARGETING EFFICIENCY MONITORS FOR HIGH ENERGY PHYSICS EXPERIMENTAL AREAS. Hornstra, F. Jr. (Argonne National Lab., IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 198-201(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Simple radiation monitors of coaxial ionization chambers are used at Fermi National Accelerator Laboratory to measure targeting efficiency of the external proton beam as it impinges on secondary particle production targets in the experimental areas. In some cases the system replaces the traditional target telescope formed of three scintillation counters connected in triple coincidence. When the target monitor is recessed in shielding, target-in, target out ratios of over 100 are achieved. A single, unshielded monitor residing near the target yields a ratio of 10 for 300 GeV incident protons on a tungsten target 120 mils in diameter by 2 in. long. A companion background monitor allows this ratio to be increased by at least an order of magnitude. Evidence indicates that these simple detectors, properly located, constitute a viable target monitoring system which has operated with incident proton beams having intensity rates ranging from less than 10^{11} protons sec^{-1} to greater than 10^{13} protons in 20 mu sec. (auth)

29380 SCINTILLATING DRIFT CHAMBERS WITH MODERATE CHARGE AMPLIFICATION. Charpak, G.; Majewski, S.; Sauli, F. (CERN, Geneva). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 202-205 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The principle of the scintillating drift chamber was recently introduced. It combines a gaseous drift space where the electrons liberated by an ionizing particle drift in an electric field, and a sensing device where the arrival of the electrons at the end of the drift space produce a flash of light detected by a photomultiplier. In contrast to an ordinary drift chamber, where the electrons are detected by the pulses of a proportional counter, the detection relies on a different principle: under proper conditions of electric field and gaseous compositions, electrons drifting in an electric field produce light without charge amplification). One advantage of this mode of operation relies on the absence of space charge effects limiting the counting rates of proportional counters. Results obtained using mixtures of Xe and N_2 are presented and discussed. (WHK)

29381 PROMPT ANGLE MEASUREMENTS WITH LARGE APERTURE SCINTILLATORS. Schneid, E. J. (Grumman Research Corp., Bethpage, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 214-216(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A technique is described for the measurement of particle trajectory angle through a pair of scintillator tiles. Signal processing provides an analog signal proportional to the tangent of the angle between the particle trajectory and the axis normal to the pair of tiles. This signal is readily available for use in fast decision logic if required: i.e., sorting energy loss signals from the tiles according to geometrical factors or restricting the events to be analyzed on the basis of incident direction. (auth)

29382 LOW POWER CAMAC DRIFT CHAMBER TIME DIGITIZER SYSTEM. Droege, T. F.; Watson, M. M.; Wesson, T. R. (Fermi National Accelerator Lab., Batavia, IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 248-250(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A drift chamber time digitizer system has been designed which combines direct counting and time stretching techniques. By time stretching for only the low order bits, most logic can be low power Schottky TTL allowing 3 channels of 3 ns time resolution in a single width CAMAC module while holding conversion time to less than 1 mu s. (auth)

29383 TWO-DIMENSIONAL PROPORTIONAL CHAMBER READOUT USING DIGITAL TECHNIQUES. Jeavons, A. P.; Ford, N.; Lindberg, B.; Parkman, C.; Hajduk, Z. (CERN, Geneva). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 259-263(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Two systems of two-dimensional proportional chamber readout are presented, using digital hardware techniques. Center-of-cluster readout is simple, cheap and very fast: 100 nsec dead-time. Center-of-gravity readout is slower, with a dead-time of 1 mu sec, but capable of considerable electronic spatial resolution: 10 mu m FWHM from 3 mm spaced channels. With this resolution the asymmetry of avalanche formation on anode wires has been observed.

29384 PROPORTIONAL CHAMBER FRONT END AMPLIFIER AND PULSE SHAPING CIRCUIT. Shapiro, S. L.; Gilchriese,

M. G. D.; McShurley, D. G. (Stanford Univ., CA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 264-268(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A proportional chamber amplifier/discriminator package has been designed to perform well under conditions of high instantaneous data rate and low duty cycle. The electronics system described is one which maximizes the detector area within the confines of a magnetic spectrometer (LASS) at the same time increasing the reliability of the system by removing all electronics from the chambers to a position of easy access. Stability of the system is enhanced by having the electronics properly cooled, preventing large temperature variations from affecting electronic thresholds and delays. We have reduced crosstalk and RF pickup problems by using shielded coaxial cables to transport the signal from the chamber to the amplifier. (auth)

29385 DEADTIMELESS SHIFT REGISTER STYLE READOUT SCHEME FOR MULTIWIRE PROPORTIONAL CHAMBERS. Shapiro, S. L.; Gilchriese, M. G. D.; Friday, R. G. (Stanford Univ., CA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 269-273(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A proportional chamber readout scheme has been developed which stores each wire's data in a 40 MHz "shift register" while a decision to retain an event is made. System delay, resolving time and storage time are adjustable parameters and multiple hits on a wire, within the storage time, are retained. (auth)

29386 NEW MONOLOTHIC INTEGRATED CIRCUIT FOR MULTIWIRE PROPORTIONAL CHAMBER (MWPC) READ-OUT SYSTEM. Bareyre, P. (CEN de Saclay, Gif-sur-Yvette, France); Borgeaud, P.; Brisson, J. C. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 274-278(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A new monolithic 8-channel PMOS integrated circuit has been developed for an experiment to be carried out on the CERN 300 GeV accelerator. The circuit, read-out electronics and tests performed on 12 large MWPC (total of 48,000 channels) are described and the results are presented. (auth)

29387 DELAY LINE READOUT TECHNIQUE APPLIED TO PROPORTIONAL CHAMBERS USING ELECTRONEGATIVE GAS MIXTURES. Lecomte, P.; Perez-Mendez, V.; Stoker, G. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 279-280(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The delay line readout technique was adapted to proportional chambers using electronegative gas mixtures. This requires lines with improved rise time, but allows somewhat shorter delays; at the same time, we improved the two-pulse resolution. Our new line is 55 cm long, has a delay to rise time ratio of 50 for a delay of 2.1 mu s; two pulse resolution in the middle of the line is of the order of 15 mm for equal amplitude pulses. We also investigated aluminum core and printed circuit delay lines. We found that the first ones are well suited for low to medium delays with medium two pulse resolution; the second ones are adapted to low delays and may have extremely good delay to rise time ratio in the differential stripline configuration. (auth)

29388 MWPC INSTRUMENTATION SYSTEM WITH SMALL DEAD-TIME AND WITH PROVISION FOR AUTOMATIC TESTING AND CALIBRATION. Olson, S. R. (Univ. of California, Berkeley); Kirsten, F.; Lee, K. L.; Turner, D. B.; Grigorian, A.; Guiragossian, Z. G. T. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 281-285(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

This paper describes some of the system features of a large array of instrumentation to be used for data collection in an experiment utilizing multi-wire proportional chambers (MWPC) of both the amplifier-per-wire and the delay-line types. The system is designed to uniquely meet special functional requirements for background reduction and dead-time reduction in high counting-rate experiments at FERMILAB. (auth)

29389 DELAY LINE MWPC HAZARD SIGNALS INSPECTOR. Turner, D. B. (Univ. of California, Berkeley); Kirsten, F.; Guiragossian, Z. G. T.; Schilling, R. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 286-288(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The Hazard Inspector is a CAMAC module which divides a MWPC delay line into 8 independent signal monitor and control segments. Independent control effectively reduces delay line occupation time and cuts the number of background and non-trigger particles accepted by the 4XQT charge-time-pulse-width digitizer, a device presented in a separate communication. Only segments containing legitimate information are digitized. Non-trigger related events are gated out at the digitizer, and contaminating hits are noted for computer correction. (auth)

29390 FOUR-DEEP CHARGE-TIME AND PULSE-WIDTH SCALING DISCRIMINATOR FOR DELAY LINE MWPC's. Lee, K. L. (Univ. of California, Berkeley); Kirsten, F. A.; Grigorian, A.; Guiragossian, Z. G. T. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 289-290(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A discriminator has been developed for digitizing both intercepted total charge and location of electromagnetic shower and particle trajectories in multi-wire proportional chambers read by delay lines. Determination of shower trajectory is aided by video signal integration followed by centroid-locating discrimination. Calibrated run-down of the signal integrating capacitor gives the charge information above a given threshold level. The discriminator is designed to handle up to four shower-induced video signals per event by incorporating steering circuits within the module. Each video signal is examined for time over an adjustable threshold. Video pulses with separation of less than 20 nsec are treated as a single pulse. Counter-logic circuits indicate the number of video signals digitized. These signal processing circuits provide a first level of data sifting which otherwise must be carried out with additional discriminator channels and added complexity in data recognition. (auth)

29391 DISTRIBUTED COMPUTER SYSTEMS IN THE LABORATORY ENVIRONMENT. Zacharov, B. (Daresbury Lab., Eng.). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 436-441 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The advent of CAMAC has had an important influence on the way in which systems are synthesized to meet the needs of data-acquisition, control and interactive computation in a laboratory environment. The modularity, standardization and widespread availability of Camac hardware, and the increasing standardization of conventional software packages have contributed greatly to the solution of highly complex system problems. In these problems, data networks are assuming a role of increasing importance. The present paper discusses these developments in the context of work done at Daresbury Laboratory, and illustrates them with specific examples. (auth)

29392 ESTIMATION OF CAPTURE CROSS SECTION OF ELECTRONS USING TRACK PARAMETERS IN NUCLEAR EMULSIONS. Sharma, A. P.; Sharma, G. P.; Vinod Kumar. (Kurukshetra Univ., India). Indian J. Pure Appl. Phys.; 13: No. 9, 599-602(Sep 1975).

An estimation of the proper magnitude of the capture cross-section of electrons at the traps in silver bromide grains of a nuclear emulsion has been made. A magnitude of the order of 10^{-15} cm^2 (in the interval 3×10^{-15}-5×10^{-15} cm^2) when used for calculating the grain density and mean gap length parameters, is found to give a satisfactory agreement with the observed experimental data. (auth)

Radiometric Instruments

Refer also to abstracts 28320, 29086, and 30655.

29393 STUDY OF SATURATION CHARACTER AND DETERMINATION OF INTERGRANULAR POROSITY OF CARBONACEOUS COLLECTORS. Lakhnnyuk, V. M. (Gosudarstvennyj Nauchno-Issledovatel'skij i Proektnyj Inst. Neftedobyvayushchej Promyshlennosti, Kiev (Ukrainian SSR)). Geofiz. Sb., Akad. Nauk Ukr. SSR, Inst. Geofiz.; No. 58, 79-81(1974). (In Russian)

5 refs.; 1 fig.

For evaluating intergranular porosity in the determination of the saturation nature and the type of interstitial space in carbonaceous collectors, acoustic logging is recommended combined with lateral logging and neutron-gamma logging. Nomograms are presented which show various relationships among the data. (tr-auth)

29394 MONITORING THE LEVEL AND PROFILE OF THE FURNACE STOCKLINE. Smolyak, V. A.; Shcherbitskii, B. V.; Evseeva, N. T.; Vasilenko, V. I.; Koloda, I. M. (Dneprodzerzhinsk Ind Inst, Ukr SSR). Metallurgist (USSR) (Engl. Trans.); 17: No. 9-10, 626-629(Sep-Oct 1973).

Based on experience with a gamma profile gage installed in 1972 in a 1719 cu m blast furnace, it is concluded that the gage can measure the configurations of the charge surface profile with an accuracy of up to ±50 to 100 mm, locate the fine iron ore materials and the large lumps of coke, and show the charge level and its speed of descent over the top diameter of large blast furnaces. (auth)

29395 MEASUREMENT OF SUBSURFACE FORMATION LITHOLOGY, INCLUDING COMPOSITION AND FLUIDS, USING GAMMA SPECTROSCOPY AND THERMAL NEUTRON DECAY. Scott, H. D. (to Texaco Inc.). US Patent 3,930,154. 30 Dec 1975. Filed Date 12 Dec 1974. 28p.

Gamma ray spectra of earth formations surrounding an open or cased well borehole are obtained by exciting subsurface formation elements around the borehole with pulsed neutrons and detecting the gamma rays resulting from capture in the subsurface formation of thermalized neutrons from a capture gamma spectroscopy (C.G.S.) well log source. The spectra of gamma rays so obtained are analyzed to form logs of the elements which contribute significantly to the spectra. Simultaneously, the time rate of decay of the number of gamma rays resulting from capture of the thermal neutrons in the formation is obtained to derive a measure of the macroscopic thermal neutron capture cross-section of the formation. The gamma rays obtained from the formation are then compensated for variations the thermal neutron capture cross-section obtained for the formation. From the logs of elements and the macroscopic thermal neutron capture cross-section of the formation, quantitative measurements of the primary formation parameters of formation water salinity, water saturation, porosity, major matrix components and ratios of formation constituents of the earth formations are obtained. (auth)

29396 PULSED NEUTRON COMBINATION WELL LOGGING SYSTEM. Peelman, H. E. (to Texaco Inc.). US Patent 3,928,762. 23 Dec 1975. Filed Date 6 May 1974. 12p.

A pulsed neutron combination well logging system for performing simultaneous logs of hydrogen/oxygen ratio, chlorine log, and thermal neutron decay time is disclosed. A downhole pulsed neutron source repetitively irradiates the borehole environs with 14 MeV neutron pulses. Some of the fast neutrons are captured by oxygen. The remaining neutrons are rapidly slowed to thermal energy and captured by other materials in the borehole vicinity. Voltage pulses representative of the capture gamma rays are sent to the surface and input to a multichannel pulse height analyzer by three time gates. Output signals from the analyzer in three different energy regions corresponding to oxygen, chlorine and hydrogen are provided. These signals are used to determine the neutron thermal decay time, the hydrogen to oxygen ratio and the chlorine content of the earth formations, thus providing a direct indication of hydrocarbon contained in the pore spaces therein. (auth)

29397 SYSTEM FOR MEASURING EARTH FORMATION THERMAL NEUTRON LIFETIME UTILIZING A HARMONICALLY INTENSITY MODULATED FAST NEUTRON SOURCE. Pitts, R. W. Jr. (to Texaco Inc.). US Patent 3,930,152. 30 Dec 1975. Filed Date 17 Jul 1974. 18p.

A system is disclosed for measuring indications of the thermal neutron lifetime of earth materials in the vicinity of a well borehole. A harmonically intensity modulated source of fast neutrons is used to irradiate the earth formations in the vicinity of a borehole with fast neutrons at three different intensity modulation frequencies. Intensity modulated clouds of thermal neutrons at each of the three modulation frequencies are detected by a single spaced detector. The tangent of phase shift of the thermal neutron intensity with respect to the fast neutron population intensity is measured at each of the three frequencies. These measurements may be appropriately combined to derive the thermal neutron lifetime of earth materials in the vicinity of the borehole. (auth)

29398 MEASUREMENT OF SUBSURFACE FORMATION LITHOLOGY, INCLUDING COMPOSITION AND FLUIDS, USING CAPTURE GAMMA SPECTROSCOPY. Scott, H. D. (to Texaco Inc.). US Patent 3,930,153. 30 Dec 1975. Filed Date 12 Dec 1974. 34p.

Gamma ray spectra of earth formations surrounding an open or cased well borehole are obtained by exciting subsurface formation elements around the borehole with neutrons and detecting the gamma ray resulting from capture in the subsurface formation of thermalized neutrons from a capture gamma spectroscopy (C.G.S.) well log source. The spectra of gamma rays so obtained are analyzed to form logs of the elements which contribute significantly to the spectra. From these logs, quantitative measurements of the primary formation parameters of formation water salinity, water saturation, porosity, major matrix components and ratios of formation constituents of the earth formations are obtained. (auth)

29399 AUTOMATIC CONTROL OF ILMENITE ORE IN A PRODUCTION LINE WITH RADIOISOTOPIC X-RAY FLUORESCENT APPARATUSES "POTOK-1" AND "CYCLE-1". Meier, V. A.; Pshenichnyi, G. A.; Rosuvanov, A. P.; Katerinov, K. S.; Pashchenko, A. A.; Barchenko, L. Yu.; Chechik, A. M. Vestn. Leningr. Univ., Geol., Geogr.; No. 3, 66-71(Aug 1975). (In Russian)

Radioisotopic X-ray fluorescent apparatus "Potok-1" and "Cycle-1" for an automatic control of ilmenite in six lines of pulp and concentrate on the conveyer have been tested and put in to action an Irshinsky ore dressing enterprise. These apparatus can be used to regulate automatically the dressing process and to control the quality of finished product.

29400 SLOW-NEUTRON MONITORING OF THIN COATINGS. Pekarskii, G. Sh.; Kurapov, V. N.; D'yakov, Yu. G. (Scientific-Research Inst. of Electronic Flaw Detection, Tomsk, USSR). Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 3, 257-260 (1975).

Translated from Defektoskopiya; 11: No. 3, 7-10(1975).

Theoretical and experimental results are presented on a neutron method of thickness monitoring for elements of high thermal-neutron capture cross section on substrates of major constructional materials of thickness up to 10 mm. The limits to the use of the method have been determined, and also the advantages over other radiation-monitoring methods.

29401 EFFECT OF THE SURFACE-DENSITY NONUNIFORMITY OF SHEET MATERIAL ON THE ENERGY SPECTRUM OF TRANSMITTED BETA RADIATION. Adamenko, A. A.; Pankratov, V. I.; Summovskii, V. V. (Scientific-Research Inst. of the Paper and Pulp Industry, Kiev). Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 3, 261-264(1975).

Translated from Defektoskopiya; 11: No. 3, 11-14(1975).

Changes taking place in the energy spectrum of beta radiation passing through inhomogeneous sheet material are analyzed. A theoretical and experimental justification is given for using the distorted energy spectrum of beta particles passing through sheet material in order to monitor surface-density nonuniformity.

29402 CHOICE OF A γ-RAY COUNTING ASSEMBLY INTENDED FOR MEASUREMENTS OF THE TRUE STEAM CONTENT BY VOLUME. Kharitonov, Yu. V. (Moskovskij Ehnergeticheskij Inst. (USSR)). Kernenergie; 18: No. 5, 135-137(1975). (In German)

Experimental determination of the true steam content by volume is preferable made using methods based on γ-ray transmission. The detectors used are scintillation counters operating in the counting or current regime. An effective linear attenuation coefficient has been found for the two regimes and its dependence on different conditions of transmission has been studied employing a ^{170}Tm source. The advantages of the detector operating in the current regime are pointed out.

29403 NUCLEAR METHODS IN ORE MINING AND THEIR CURRENT APPLICATIONS. Simon, L. (Ceskoslovenska Akademie Ved, Prague. Horniczy Ustav). Rudy (Prague); 25: No. 2, 42-46(Feb 1975). (In Czech)

A brief review is presented on the current state of applicability of nuclear methods in ore mining in Czechoslovakia and abroad. The methods of radioactivity logging of Pb + Zn, Sn, Cu, CaF_2, and Be ore deposits in exploration and survey are outlined. The application is described of nuclear methods in auxiliary work in ore treatment plants and in ore treatment and processing. The future trends of the development and application of nuclear methods in ore mining in Czechoslovakia are indicated.

29404 ATTEMPT TO USE ABSORPTION OF α AND β RADIATION TO DETERMINE DUST MASS COLLECTED ON FILTERS. Wiecek, E.; Domanski, T.; Chruscielewski, W.; Stroszejn, G. (Instytut Medycyny Pracy w Przemysle Wlokienniczym i Chemiczynm, Lodz (Poland)). Med. Pr.; 25: No. 2, 143-148(1974). (In Polish)

Attempts were made to use absorption of α and β radiation to determine dust mass collected on membrane filters. Therefore mass coefficients of radiation absorption (K_i) for α and β radiation, relative standard deviation of the coefficients (Sr) and sensitivity (G min) were determined for cork, coal, silica, lead oxide and sugar dusts. Measurements of dust concentration using absorption of β radiation may be of use especially for determination of atmospheric dust pollution on working premises. Methods employing α radiation though more precise and sensitive may be used only for determination of dusts for which calibration has been previously done.

29405 TRANSACTIONS OF THE SPWLA SIXTEENTH ANNUAL LOGGING SYMPOSIUM, NEW ORLEANS, LOUISIANA, JUNE 4–7, 1975. Houston, TX; Society of Professional Well Log Analysts Inc. (1975). vp. (CONF-750643-); $15.00.

The 37 papers presented were compiled. Individual abstracts were prepared for 10 papers for NSA. All items were included in ERA. (JSR)

For abstracts of individual papers see: 29092, 29343, and 29406–29412.

29406 MEASURING THERMAL NEUTRON ABSORPTION CROSS SECTIONS OF FORMATION BRINES. Rinehart, C. E.; Weber, H. J. pp G.1-14 of Transactions of the SPWLA Sixteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts Inc. (1975).

From 16th annual logging symposium; New Orleans, Louisiana, USA (4 Jun 1975). See CONF-750643-.

A recently developed neutron absorption cell measures the thermal neutron absorption cross sections of formation brines (SIGMA /sub w/). This is one of the parameters needed for interpreting pulsed neutron decay logs. Generally, SIGMA/sub w/ is estimated for the salinity of the brine. Sometimes it can be measured in a large tank with a logging tool, but this requires several hundred gallons of the brine. With the neutron absorption cell, this measurement can be made on a sample as small as one gallon, with a precision of 0.1 percent, in less than 5 minutes. Seventeen brine samples from oil fields in the U. S. and Canada have been analyzed in the cell. The cross sections measured have been compared with cross sections calculated from chemical analyses. The analyses included atomic absorption measurements to determine the concentration of boron in the samples. In almost all cases, boron contributed a noticeable amount to the total absorption cross section. In one brine, over 8 percent of the cross section was attributed to boron. Sodium, chlorine, and the hydrogen in the water were the only other elements that contributed appreciably to the cross section. The calculated and measured cross sections agreed within the experimental errors of the chemical analyses. (auth)

29407 NEUTRON LOGGING IN PARTIALLY SATURATED MEDIA. Hearst, J. R. (Univ. of California, Livermore). pp I.1-19 of Transactions of the SPWLA Sixteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts Inc. (1975).

From 16th annual logging symposium; New Orleans, Louisiana, USA (4 Jun 1975). See CONF-750643-.

At the Lawrence Livermore Laboratory the behavior of epithermal neutron logging equipment in large holes in partially saturated alluvium and in ashfall and ashflow tuff is being studied. Monte Carlo neutron transport calculations indicate that the number of epithermal neutrons from either a fission or 14-MeV source depends not only on the water content of the medium, but also on its bulk density. Curves as functions of both parameters have been developed and an interpolation method devised. Attempts to calibrate neutron logs by comparing log-measured water content with water content from cores result in unacceptably large errors. Part of the error is due to the fact that commercial neutron logs are quite sensitive to hold size variations. It is shown that with proper shielding the hole size effect can be eliminated. An effort is in progress to study the two water contents, bulk density, and material type in a number of holes to determine whether core data calibration would be satisfactory with proper corrections. (auth)

29408 INFLUENCE OF BOUND WATER ON THE NEUTRON LOG IN MINERALIZED IGNEOUS ROCK. Nelson, P. H.; Glenn, W. E. (Kennecott Exploration, Inc., Salt Lake City). pp M.1-9 of Transactions of the SPWLA Sixteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts Inc. (1975).

From 16th annual logging symposium; New Orleans, Louisiana, USA (4 Jun 1975). See CONF-750643-.

In mineralized igneous rocks, the structural (bound) water present in the form of alteration minerals contributes significantly to the response of the neutron log. Two examples in low porosity rock are presented where the bound water actually dominates the log response. The neutron response equation must be modified to account for this effect and as a result the crossplot relationships are also modified. For the neutron-sonic and the neutron-density cross plots, the bound water term is conveniently incorporated in newly-defined expressions for an apparent matrix transit time and an apparent grain density. (auth)

29409 DEPTH OF INVESTIGATION OF NEUTRON AND DENSITY SONDES FOR 35-PERCENT-POROSITY SAND. Sherman, H.; Locke, S. (Schlumberger-Doll Research Center, Ridgefield, CT). pp Q.1-14 of Transactions of the SPWLA Sixteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts Inc. (1975).

From 16th annual logging symposium; New Orleans, Louisiana, USA (4 Jun 1975). See CONF-750643-.

Depths of investigation have been measured for the following sondes: Compensated Formation Density (FDC*), Sidewall Neutron (SNP*), and two types of two-detector Compensated Neutrons (CNL*), namely the thermal tool (CNT-A) and an experimental epithermal tool (CNT-X). The measurement was carried out in a 35-percent-porosity laboratory sandstone formation. The laboratory formation was made up of separated concentric annuli 1-in. and 2-in. thick, each filled with sand. The formation was initially dry. The annuli were saturated with water, one after another, beginning with the annulus next to the borehole. After each annulus in sequence had become fully saturated the response of the sonde was recorded. Curves of tool response and individual-detector response, versus depth of saturation measured from the borehole wall, were thus obtained. From these curves, depths of investigation are derived. Depth of investigation depends upon source-detector spacing as well as upon energy of neutron detection. In support of the experiment, theoretical calculations for the neutron sondes were done using one-group diffusion theory. These results are compared with those from the experiments. (auth)

29410 COMPUTED DEPARTURE CURVES FOR THE THERMAL NEUTRON DECAY TIME LOG. Locke, S. (Schlumberger-Doll Research Center, Ridgefield, CT); Smith, R. pp S.1-22 of Transactions of the SPWLA Sixteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts Inc. (1975).

From 16th annual logging symposium; New Orleans, Louisiana, USA (4 Jun 1975). See CONF-750643-.

The Thermal Neutron Decay Time (TDT) Log has become an important tool for formation evaluation in cased holes. For accurate interpretation of this log, it is necessary to know how to correct for borehole effects and for the effect of spatial diffusion of thermal neutrons. Some experimental measurements of tool response have been made in laboratory formations. However, these are limited as to the cases that can be handled, and they are very time-consuming. Furthermore, for the many situations that arise in logging practice, results are needed for a wide range of formation porosities, formation salinities, hole sizes, casing sizes, and borehole salinities. For this reason, a computer program has been developed to calculate tool response under various conditions. The nature of the program and its uses and limitations are described. Some indications of its use are also given. Illustrative computed departure curves are shown for the TDT-K tool, which is in wide use at the present time. A log example is shown. (auth)

29411 REFINED RESERVOIR DESCRIPTION TO MAXIMIZE OIL RECOVERY. Flewitt, W. E. (Imperial Oil Ltd., Calgary, Alberta). pp X.1-22 of Transactions of the SPWLA Sixteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts Inc. (1975).

From 16th annual logging symposium; New Orleans, Louisiana, USA (4 Jun 1975). See CONF-750643-.

To assure maximized oil recovery from older pools, reservoir description has been advanced by fully integrating original open-hole logs and the recently introduced interpretive techniques made available through cased-hole wireline saturation logs. A refined reservoir description utilizing normalized original wireline porosity logs has been completed in the Judy Creek Beaverhill Lake "A" Pool, a reefal carbonate pool with current potential productivity of 100,000 BOPD and 188 active wells. Continuous porosity was documented within a reef rim and cap while discontinuous porous lenses characterized an interior lagoon. With the use of pulsed neutron logs and production data a separate water front and pressure response was recognized within discrete environmental units. The refined reservoir description aided in reservoir simulation model studies and quantifying pool performance. A pattern water flood has now replaced the original peripheral bottom water drive to maximize oil recovery. (auth)

29412 MECHANICS OF LOG CALIBRATION. Waller, W. C.; Cram, M. E.; Hall, J. E. (Schlumberger Well Services, Houston, TX). pp GG.1-20 of Transactions of the SPWLA Sixteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts Inc. (1975).

From 16th annual logging symposium; New Orleans, Louisiana, USA (4 Jun 1975). See CONF-750643-.

For any measurement to have meaning, it must be related to generally accepted standard units by a valid and specified system of comparison. To calibrate well-logging tools, sensing systems are designed which produce consistent and repeatable indications over the range for which the tool was intended. The basics of calibration theory, procedures, and calibration record presentations are reviewed. Calibrations for induction, electrical, radioactivity, and sonic logging tools will be discussed. The authors' intent is to provide an understanding of the sources of errors, of the way errors are minimized in the calibration process, and of the significance of changes in recorded calibration data. (auth)

29413 X-RAY FLUORESCENCE INDUCED BY PROTONS. Application to Quantitative Analysis. Demortier, G. (Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium)). pp 224-231 of Electron and Ion Beam Processes Applications. 4th International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French)

From 4th international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces no. 171.

A quantitative microanalysis of elements with an atomic weight greater than 30, from the radiation induced by 100 to 3000 keV proton bombardment is possible with sensitivities varying from 1 to 10 ppm as a function of the elements considered. Emphasis is put upon the question of the sensitivity and accuracy inherent to the method, and correction calculations for the absorption of x radiation emitted from bombarded targets with thickness exceeding the incident proton range. Examples of application to metallic and biological samples are given.

29414 APPLICATION OF GAMMA-LOGGING METHOD IN SOLVING SOME PROBLEMS OF EXPLORATION CONTROL UNDER CONDITIONS OF UZEN FIELD. Asmolov, V. S.; Talamanov, E. N.; Khramtsov, A. Ya. Nefteprom. Delo; No. 3, 8-10(1974). (In Russian)

29415 TWO-PHASE FLUID DENSITY MEASUREMENT WITH A TWO-BEAM RADIATION ATTENUATION DENSITOMETER. Lassahn, G. D. (Aerojet Nuclear Co., Idaho Falls, ID). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 357-358(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Using prior knowledge or assumptions about possible distributions of the two phases, the average density and the density distribution of a two-phase fluid in a pipe can be determined with a two-beam radiation attenuation densitometer. The procedure for using such a system is outlined and illustrated with an example. (auth)

29416 HEAT SHIELD ABLATION SENSOR UTILIZING CdTe GAMMA DETECTORS. Droms, C. R. (General Electric Co., Philadelphia); Langdon, W. R.; Robison, A. G.; Entine, G. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 498-500(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A miniaturized, flight proven gamma sensor embodying a CdTe device has been developed for applications of gamma backscatter to measurement of heat shield recession and nosetip shape change. A 10 mm diameter by 2 mm thick chlorine doped CdTe gamma detector operated at circa 50 volts bias was combined with an unusual preamplifier employing tripolar pulse shaping. The package, which incorporates mechanical isolation, damping, and component rigidization, has operated satisfactorily under test at a random vibration level of 2 g^2/sub c//Hz and peak sinusoidal acceleration of 10,000 g/sub c/ at a frequency of 24 kHz. Several of these gamma sensors have been flown in a single vehicle to obtain measurements of changes in nosetip shape. (auth)

29417 DESIGN STUDY OF A 200 keV SCANNING PROTON MICROPROBE USING A FIELD IONIZATION SOURCE. Singh, M.; Meivin, J.; Cho, Z. H. (Univ. of California, Los Angeles). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 657-661(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A preliminary design study has been conducted for constructing a 200 keV scanning proton microprobe which utilizes the phenomenon of field ionization in hydrogen gas to create a proton source of extremely small dimensions and high "brightness." Calculations for the focusing action of a non-uniformly graded accelerating column, in conjunction with a superconducting magnetic solenoid indicate a final beam-spot size better than 50 A. The ultimate aim is to construct a high energy proton or heavy-ion microprobe which will rival or even excel the field emission scanning electron microscopes presently in use. Justification for using high energy protons (or heavy-ions) as probe particles instead of electrons is presented in this paper, along with details of the beam transport and focusing system. (auth)

29418 NEUTRON METHOD FOR FIELD ANALYSIS OF PLASTIC CONCRETE. Taylor, M. C. (Columbia Scientific Industries, Austin, TX). Anal. Instrum.; 12: 165-172(1974).

From 20th annual ISA analysis instrumentation symposium; Pittsburgh, PA, USA (12 May 1974).

A technique has been developed which employs two neutron sources (^{252}Cf and ^{238}Pu-Be) and three NaI(Tl) detectors to determine the H, Ca, Si and C content of calcareous aggregate concrete in its plastic state. These elements are indicative of the water, cement, fine aggregate and coarse aggregate components which along with air entrainment are key factors in strength determination. Data are presented which demonstrates the feasibility of the technique for analysis of typical samples in a total time of the order of 10 minutes. (auth)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 29291.

29419 (AD/A-008368) ANALYSIS OF THE RESPONSE OF A CONDUCTOR IMMERSED IN AN EMP SOURCE REGION-THE STEADY STATE. Topical Report. Mo, C. T. C. (R and D Associates, Santa Monica, Calif. (USA)). 24 Jan 1975. 49p. (RDA-TR-2301-009). NTIS $3.75.

The problem of a conducting body immersed in air and illuminated by a gamma-ray flux is discussed. In this EMP source coupling region, the charge, the current, and the field at the conducting body are of interest. A scheme was formulated for solving this problem by carefully decomposing the interaction into its various basic aspects concerning the effects of the incident gamma-rays only, of the driving Compton electron current, and of the ionized air conductivity. The effects are examined both separately and in combination. The author solves a simple case involving an infinitely-conducting and infinitely-dense spheroidal conductor illuminated by a "steady" stream of gamma rays. This solution provides physical insights into the EMP source region effects and illustrates the scheme of theoretical analysis for more complex problems. Numerical results are developed for illustrative high-altitude EMP exposures. Finally, a scheme is outlined to solve the time-dependent problem by extending the above method.

29420 RADIATION DOSE-RATE DEPENDENCY IN SATELLITE OSCILLATORS AND SOLAR CELLS. Faraday, B. J.; Statler, R. L. (Naval Research Lab., Washington, D. C. (USA)). pp 831-843 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

An investigation of radiation effects in the external and internal components of satellites shows that the testing of these devices should be carried out at dose rates similar to those encountered in space. Lithium-doped solar cells were irradiated to the same total integrated fluence with ^{60}Co gamma rays at a rate comparable with the Van Allen radiation environment and with 1 MeV electrons from a Van de Graaff accelerator at orders of magnitude higher dose rate. Measurements of the photovoltaic current-voltage characteristics with a solar simulator showed that more damage resulted from the irradiation at the lower dose rate. Likewise, quartz oscillators used as frequency control devices on navigational satellites were irradiated by ^{60}Co gamma rays at various dose rates to the same total absorbed dose. Measurements of the radiation-induced decrease in the resonant frequency showed that the degradation was strongly influenced by the dose rate for exposures comparable with those received in space over a period of several years. In particular, crystals irradiated at a dose rate typical of the shielded interior of a satellite at an altitude of 14,000 km showed greater degradation than those irradiated at higher dose rates.

29421 JUPITER'S RADIATION BELTS AND THEIR EFFECTS ON SPACECRAFT. Parker, R. H.; Divita, E. L.; Gigas, G. (California Inst. of Tech., Pasadena (USA)). pp 93-133 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

The effects of electron and proton radiation on spacecraft which will operate in the trapped radiation belts of the planet Jupiter are considered, and the techniques and results of the testing and simulation used in the radiation effects program at the Jet Propulsion Laboratory (JPL) are discussed. Available data from the Pioneer 10 encounter of Jupiter are compared with pre-encounter models of the Jupiter radiation belts. The implications that the measured Jovian radiation belts have for future missions are considered.

29422 IMPROVEMENT OF THE RESISTANCE TO RADIATION OF BIPOLAR SILICON PLANAR TRANSISTORS. Baeuerlein, R. (Siemens A. G., Erlangen (F. R. Germany). Forschungslabora-

torium). pp 723-735 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

A process is reported with which the ionization damage of bipolar silicon planar transistors can be greatly reduced. This process consists of an irradiation-temperature treatment for prepared transistor units (dose 10^9 - 10^{10} rad, temperature 200-300 deg C) followed by a bias-temperature treatment to complete the annealing of the radiation damage, produced by the preceding step. With this hardening process npn transistors are more suitable than pnp transistors. The results are shown for two types of silicon npn transistors. One type has a very thin base region and hence is already insensitive to displacement damage. The physical reasons for the improvement effect are also discussed.

29423 INFLUENCE OF THE SILICA GROWTH ON THE RADIATION DAMAGES IN MOS COMPONENTS. Sarrabayrouse, G.; Buxo, J. (Centre National de la Recherche Scientifique, 31 - Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes) pp 777-784 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974). (In French).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

The dependence of the radiation sensitivity of M.O.S. components on some of the technological parameters involved in M.O.S. fabrication was studied. The parameters considered are the nature of the metallic electrode and water content of the oxide film. Effects of thermal post-oxidation treatments are also considered. Results obtained show that in the case of wet oxides without post-oxidation treatments the extent of the degradation effect is controlled by the conditions of humidity under which the oxide is obtained and the chemical reactivity of the metallic electrode is shown. The role of ionic phenomena in these experiments is discussed.

29424 SIMULTANEOUS ELECTRON–PROTON IRRADIATION OF CRUCIBLE GROWN AND FLOAT-ZONE SILICON SOLAR CELLS. Bernard, J. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 31 - Toulouse (France). Centre d'Etudes et de Recherches); Crabb, R. L. (European Space Research and Technology Centre, Nordwijk (Netherlands)). pp 639-650 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

The realization of an irradiation chamber which permits simultaneous irradiations by electrons, protons, photons and in-situ measurements of solar cells main parameters (diffusion length, I.V. characteristics) is described. Results obtained on 20 solar cells n/p 10 Ωcm made in silicon pulled crystals and 20 solar cells n/p 10 Ωcm made in silicon float-zone simultaneously irradiated with electrons and photons are given.

29425 IRRADIATION EFFECTS ON HIGH EFFICIENCY Si SOLAR CELLS. Nguyen Duy, T.; Amingual, D.; Colardelle, P. (Societe Anonyme de Telecommunications, 75 - Paris (France)); Bernard, J. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 31 - Toulouse (France). Centre d'Etudes et de Recherches). pp 651-657 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974). (In French).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

By optimizing the diffusion parameters, high efficiency cells are obtained with 2 ohms × cm (13.5% AMO) silicon material. These new cells have been submitted to radiation tests under 1 MeV and 2 MeV electrons and 2,5 MeV protons. Their behavior under irradiation is found to be dependent only on the bulk material. By using the same resistivity silicon, the rate of degradation is exactly the same as those of conventional cells. The power increase, due to a better superficial response of the cell, is maintained after irradiation. These results show that new high efficiency cells offer an E.O.L. power higher than conventional cells.

29426 EFFECT OF MIXED RADIATION FIELDS ON ELECTRONIC DEVICES. Schoenbacher, H.; Lambert, K. P.; van de Voorde, M. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 755-764 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

The successful operation of high-energy particle accelerators and storage rings depends upon the reliability of electronic devices. Primary high-energy protons, which are lost during machine operation, produce secondary particle fluxes of protons, neutrons, pions, gammas, etc., sufficiently high to seriously affect the performance of electronic devices. In order to avoid drastic failure during machine operation due to radiation damage of electronic components, simulation tests have been carried out in different radiation sources, for example, nuclear reactors, near the existing CERN accelerators and in gamma irradiators. The performance of individual components, such as diodes, capacitors, transistors and integrated circuits was studied under different sources and conditions. The results of these investigations are given as well as a comparison of damage effects in different radiation environments.

29427 IRRADIATION TEST PROCEDURE AND RELIABILITY ASPECTS OF ELECTRONIC DEVICES FOR THE SYMPHONIE SATELLITE. Spencker, A.; Braeunig, D.; Wagemann, H. G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Datenverarbeitung und Elektronik). pp 765-775 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

Irradiation tests of 35 electronic components originating in general from lots qualified for the Symphonie satellite have been performed using 1.6 MeV electrons up to appropriate test fluences of 10^{14} and 10^{15} cm^{-2}. Before any test, the conditions for irradiation, measurements, and documentation were verified to be identical. CAMAC instrumentation proved an equipment easy to handle for parts of the measurements. Typical results are presented as tables establishing different categories of reliability. Some experience which may be useful for future testing is summarized. Reliability is analyzed in detail for high voltage diodes and opto-couplers (GaAs-LED + Si-phototransistor), a test in which significant degradation appeared. A screening irradiation (maverick selection) was achieved for high voltage diodes, using ^{60}Co irradiation with subsequent annealing for the optocouplers. Damage aspects are presented which suggest an exclusion of this particular device combination in spite of the use of additional shielding.

29428 OPTIMIZATION OF SOLAR CELL SHIELDING FOR GEOSTATIONARY MISSIONS. Walkden, M. W. pp 697-715 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

Equivalent 1 MeV electron fluences, end of life output powers and power to weight ratios are estimated for solar cells in a five year geostationary mission beginning in 1975. The study covers cell thicknesses from 125μm to 300μm, coverslip thicknesses from 25μm to 300μm, rear shielding typical of rigid and lightweight flexible arrays, and infinite rear shielding. It is concluded that the thinnest cells and shielding give the best power-to-weight ratio, although the choice for a particular spacecraft will be influenced by considerations of availability, cost, fragility and array area. (FR)

29429 INVESTIGATION OF SOLAR CELL RADIATION DAMAGE. Bernard, J.; Reulet, R. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 31 - Toulouse (France). Centre d'Etudes et de Recherches); Arndt, R. A. (Communications Satellite Corp., Clarksburg, Md. (USA). COMSAT Labs.). pp 675-684 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

Development of communications satellites has led to the requirement for a greater and longer lived solar cell power source. Accordingly, studies have been undertaken with the aim of determining which solar cell array provides the greatest power at end of life and the amount of degradation. Investigation of the damage done to thin silicon and thin film CdS solar cells is being carried out in two steps. First, irradiations were performed singly with 0.15, 1.0 and 2.0 MeV electrons and 0.7, 2.5 and 22 MeV protons. Solar cells and their cover materials were irradiated separately in order to locate the sites of the damage. Diffusion length and

I.V. characteristics of the cells and transmission properties of the cover materials were measured. All measurements were made in vacuum immediately after irradiation. In the second part it is intended to study the effect of various combinations of proton, electron and photon irradiation both with and without an electrical load. The results of this part show whether synergism is involved in solar cell damage and the relative importance of each of three radiation sources if synergism is found.

29430 IRRADIATION TESTS ON COSMOS INTEGRATED CIRCUITS USING A Sr SOURCE. Ponomarenko, S. (Centre National d'Etudes Spatiales, 31 - Toulouse (France)). pp 737-754 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974). (In French)

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

Comparative tests between two irradiation modes were performed. Structures used for testing these modes are CMOS integrated circuits. With the help of electrical parameters the most significant observed drifts on each lot of components are described. Conclusions relate on the one hand the behavior of the components under irradiations and on the other hand advantages and disadvantages of the modes used.

29431 PREDICTION OF THE GAIN DEGRADATION INDUCED BY NEUTRONS IN DIPOLAR TRANSISTORS: SPECTRUM DEPENDENCE, ELECTRICAL CHARACTERISTIC CORRELATIONS. Burkhart, A. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). pp 797-811 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974). (In French)

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

An original evaluating method of gain degradation has been found for neutron irradiated transistors. It establishes a correlation between degradation and the product of two coefficients: spectra factor and an electrical parameter which is measured or directly deduced from manufacturer's data. Equivalence for several types of spectra (fission, 14 MeV) and degradation sensitivity to electrical parameters of individual components of a batch are obtained.

29432 INFLUENCE OF SOLAR CELL BASE MATERIAL ON HIGH ENERGY PARTICLE DEGRADATION. Bebermeier, H.; Schulz, B. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Wedel/Holstein (F. R. Germany)). pp 659-673 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

19 different solar cell types have been subjected to an extensive electron irradiation programme and their degradation has been investigated as function of the temperature and the radiation dose. Uncovered solar cells have been subjected to radiation levels up to $5 \cdot 10^{15} \cdot MeVe^{-}/cm^{2}$ and have been measured electrically between –60°C and +100°C.

29433 RADIATION EFFECTS ON HIGH EFFICIENCY SILICON SOLAR CELLS. Luft, W. (TRW Systems, Redondo Beach, Calif. (USA)). pp 627-638 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

Three manufacturers in the U.S. are producing high efficiency cells with enhanced response for short wave radiation (0.3–0.5μm). These cells differ in design (base resistivity, backfield, grid lines, etc.), and manufacturing processes from each other. Basic characterizations of the electrical parameters are presented, such as: current-voltage characteristics, spectral response, temperature coefficients. The performance data are given for two types of covers, viz., fused silica with 350-nm ultraviolet reflection filter and 5% CeO doped glass. The cells have been subjected to 1-MeV electron irradiation to determine degradation characteristics of short circuit current, open circuit voltage, and maximum power. Comparison of this data is made to conventional N/P silicon solar cell characteristics. For such degradation study, the spectrum of the light source and its calibration are of paramount importance for accuracy in the data. High efficiency cells were calibrated by high altitude balloon flight. These cells were then used for light flux calibration using both continuous and pulsed xenon solar simulators. The spectra were measured with a spectroradiometer.

29434 RADIATION SHIELDING FOR QUARTZ CRYSTALS IN SATELLITES. McCrary, J. H. (Naval Research Lab., Washington, D. C. (USA)). pp 39-44 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

The degrading effects of Van Allen radiation on the frequency characteristics of satellite-born quartz crystal oscillators can be significantly reduced by appropriate shielding. A light-weight shield capable of reducing the absorbed dose in the quartz crystal to less than a rad per day was designed for the forthcoming Navy Timation III navigational satellite. The shield consists of an aluminum-lead-aluminum configuration in which the external satellite skin is the first aluminum component and the crystal oscillator is surrounded by concentric shields of aluminum and lead. Theoretical and experimental data were obtained to determine the effectiveness of this shield as a function of the thicknesses of the three layers for various incident electron fluxes.

29435 EFFECTS OF COMBINED ELECTRON AND PHOTON IRRADIATION ON Si SOLAR CELL DEGRADATION. Gasset, G.; Castaner Munoz, L.; Bielle-Daspet, D. (Toulouse-3 Univ., 31 (France). Centre d'Etude Spatiale des Rayonnements). pp 607-625 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974). (In French)

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

The effects of the successive irradiations by 1 or 4.5 MeV electrons and by photons on the degradation of n^{+}/p, 10 ohm/cm, solar cells are studied by their effects on the minority carrier lifetime in the solar cell base. Properties of the resulting damage are deduced from the variation in carrier lifetime vs carrier injection rate, annealing temperature and silicon material characteristics: boron or aluminium doping floating zone or crucible-grown crystal. The results show that the photon bombardment effect on the degradation of electron-irradiated solar cell comes from the annealing and/or the enhancement of certain carrier recombination centers. These centers do not require boron, aluminium oxygen atoms, except for one of them which could be a boron-vacancy complex and whose concentration is increased by the photon bombardment. It thus appears that photon-bombardment following electron-irradiation seems to modify the solar cell degradation whatever the silicon dopant of oxygen content may be.

29436 IRRADIATION BEHAVIOR OF COMPLEMENTARY METAL OXIDE SEMICONDUCTOR FIELD EFFECT (CMOS) DEVICES. Wagemann, H. G.; Braeunig, D.; Kaempf, U.; Spencker, A. (Hahn-Meitner-Institut fuer Kernsforschung Berlin G.m.b.H. (F. R. Germany). Bereich Datenverarbeitung und Elektronik). pp 785-796 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

investigated by means of high energy electrons and x-rays for different operating conditions. Change of transfer characteristics and drain current level are individually related to NMOST and PMOST properties. Their deterioration is explained by MOS capacitor behavior, which provides the principal parameters of CMOS radiation damage for ionizing radiation: flat-band voltage and quantities of donor and acceptor type and oxide charge. Their mutual dependence is discussed. For thermal oxides their increase after irradiation exposure is predominantly related to irradiation biasing and less to technological conditions. Space applications aspects and reliability limits for conventional CMOS circuitry is evaluated, as well as radiation hardening and thermal annealing.

29437 EFFECTS OF ELECTRON-BEAM IRRADIATION ON THE PROPERTIES OF CVD Si_3N_4 FILMS IN MNOS STRUCTURES. Ma, T.P. (IBM System Products Division, East Fishkill, Hopewell Junction, New York 12533); Yun, B.H.; DiMaria, D.J.; Scoggan, G.A. J. Appl. Phys. 47: No. 4, 1599-1604 (Apr 1976).

The influence of energetic electron-beam irradiation on the trap properties of CVD Si_3N_4 films in MNOS structures has been investigated by means of charge-centroid and conduction measurements. Within the limit of our measurements, the results indicate that electron-beam radiation up to 6.6×10^{-3} C/cm² does not affect the trap properties of the nitride, such as the density, capture cross section, and average capture distance, although the charging of these traps may be altered. Furthermore, the effects of radiation in the $Si-SiO_2$ interface

properties of MNOS structures have been examined by the C-V method. For an MNOS capacitor with relatively thick oxide, radiation was found to cause a significant increase in the density of surface states, the effective insulator charge, and the slow states. For an MNOS capacitor with very thin oxide, by contrast, the radiation causes a significant change only in the insulator charge—none in the surface states. Since the properties of the nitride have not been affected by the irradiation, the difference in effects must be due to the difference between the oxide films. An explanation based on a broken-bond model is consistent with the results. (auth)

29438 IMPROVED YIELDS FOR MOST's USING ION IMPLANTATION. Brockman, H.E. (Mullard Research Laboratories, Redhill, Surrey, England). J. Appl. Phys. 47: No. 4, 1716-1718 (Apr 1976).

Conventionally diffused source and drain polysilicon gate MOST's commonly exhibit one type of fault, namely, that of polysilicon-to-diffusion short circuits. Investigations into the yields of large-area devices fabricated using ion-implanted sources and drains are compared with those of diffused structures. An improved technology for the chemical shaping of the polysilicon gates, which improves the yields for both types of devices, is also described. (auth)

29439 EFFECTS OF 33-MeV PROTON BOMBARDMENT ON THE PERFORMANCE OF CdTe GAMMA-RAY DETECTORS. Nakano, G. H.; Imhof, W. L.; Kolner, J. R. (Lockheed Palo Alto Research Lab., Palo Alto, CA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 468-472(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A measurement program to investigate the performance of CdTe gamma-ray detectors after bombardment with 33-MeV protons has been undertaken in order to evaluate the effects of energetic protons encountered on earth-orbiting satellites. The pulse heights and energy resolutions of the 59.6 keV line from ^{241}Am and the 122 keV line from ^{57}Co and the leakage currents of the detectors were monitored as a function of proton fluence. Of the two types of CdTe detectors tested, far greater radiation effects were observed in those obtained from Tyco (chlorine doped) than in the sensor obtained from Hughes (indium doped). In the former detectors the relative pulse heights appeared to decrease slowly with increasing fluence up to about (5-9) x 10^9 protons/cm^2 beyond which the gain degraded at a faster rate. The energy resolution and leakage currents were observed to improve at moderate fluence levels near (1-3) x 10^9 protons/cm^2. In one of the two chlorine doped sensors tested, the intrinsic detector resolution at 59.6 keV improved from 4.3 keV to 2.6 keV at a fluence of 2 x 10^9 protons/cm^2 and subsequently degraded beyond its original performance level after 5 x 10^9 protons/cm^2. (auth)

29440 RADIATION TOLERANCE OF AMORPHOUS SEMICONDUCTORS. Nicolaides, R. V.; DeFeo, S.; Doremus, L. W. (Feltman Research Lab., Dover, NJ). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 839-848(Feb 1976)

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

In an attempt to determine the threshold radiation damage in amorphous semiconductors, radiation tests were performed on amorphous semiconductor thin film materials and on threshold and memory devices. The influence of flash x-rays and neutron radiation upon the switching voltages, on- and off-state characteristics, dielectric response, optical transmission, absorption band edge and photoconductivity were measured prior to, during and following irradiation. These extensive tests showed the high radiation tolerance of amorphous semiconductor materials. Electrical and optical properties, other than photoconductivity, have a neutron radiation tolerance threshold above 10^{17} nvt in the steady state and 10^{14} nvt in short (50 mu sec to 16 msec) pulses. Photoconductivity increases by 1½ orders of magnitude at the level of 10^{14} nvt (short pulses of 50 mu sec). Super flash x-rays up to 5000 rads (Si), 20 nsec, do not initiate switching in off-state samples which are voltage biased up to 90 percent of the threshold voltage. Both memory and threshold amorphous devices are capable of switching on and off during nuclear radiation transients at least as high as 2 x 10^{14} nvt in 50 mu sec pulses. (auth)

29441 RADIATION EFFECTS ON LOW POWER SCHOTTKY DIGITAL INTEGRATED CIRCUITS. Cooper, M. S. (GTE Sylvania, Needham Heights, MA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 853-859(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Typical low power Schottky integrated circuits were exposed to two standard radiation environments to obtain characteristic radiation response in comparison to standard TTL. The neutron levels were 1.9 x 10^{12} and 2.1 x 10^{13} neutron/cm^2 (californium-252 spectrum). The gamma dose rates were 7 x 10^9 to 3.8 x 10^{10} rads (Si)/sec (100 nanosecond pulse width). Neutron response was minimal – beta degraded less than 10 percent, other parameters shifted less than 5 percent. Photocurrents were roughly 50 to 100 percent higher than the standard TTL. Results indicate that LS series IC's were at least as neutron hard as typical standard TTL devices but may fail at a factor of 2 to 10 times lower gamma dose rate. (auth)

Miscellaneous Instruments

Refer also to abstracts 30005, 31638, 32280, 32495, 32501, and 32502.

29442 (EUR-5217) METEOROLOGICAL TRACERS IN REGIONAL PLANNING. Mueller, K. H. (Commission of the European Communities, Brussels (Belgium)). Nov 1974. 30p. (In German). INIS.

An automatic air sampling system for use with atmospheric tracers which can determine the meteorological and topological situation of an urban region and its surroundings is discussed. (auth)

29443 REMOTE APPLICATION OF AN OSCILLATORY SYSTEM FOR DENSITY MEASUREMENTS. Fortsch, E. M.; Wade, M. A. (Idaho Chemical Corp., Idaho Falls). Conf. Remote Syst. Technol., Proc.; 22: 30-33(1974).

From 22nd conference on remote systems technology; Washington, DC, USA (Oct 1974).

An Anton-Paar densimeter was modified for remote use and installed in the Remote Analytical Facility of the Idaho Chemical Processing Plant. This instrument determines density by measuring the deviation in resonant frequency of a hollow-glass mechanical oscillator when filled with sample material. The volume of the oscillator is constant and any change in its frequency is due to the sample. The change in frequency is a measure of the mass of the sample. Since there is no need to measure either volume or mass, the remote manipulations are simplified. This unit replaced existing falling-drop equipment with a reduction in cost and improvement of precision. The remote unit is used routinely 24 h a day with a precision of better than +- 5 x 10^{-4} g/ml. (auth)

29444 DESIGN OF A DIGITAL LOGARITHMIC RATEMETER CIRCUIT. Osborne, R. V. (Chalk River Nuclear Labs., Ont.). IEEE Trans. Nucl. Sci.; NS-22: No. 3, 1952-1957(Jun 1975).

The state of a binary counter that has accumulated pulses is digitally converted to a logarithmic representation to base 2. The characteristic is determined by a shift register which locates the leading bit. A 3-bit mantissa over a factor of 2 is generated by a logic look-up table from the second to the fifth most significant bits. The root mean square error in the mantissa is 2.7 percent and the maximum error is 6.6 percent. The output signal is derived from a digital-to-analog converter. In a particular application where the analog output is displayed on a 5-decade scale for counting rates from 0.1 s^{-1} to 10^4 s^{-1}, the maximum error from conversion is less than 1 percent of full-scale reading. Up to 8 decades may be displayed. The minimum counts to be accumulated before conversion, and hence the statistical accuracy, may be preset. The shortest counting time is 5s but longer times, up to 640s, are automatically allowed in order to satisfy a preset count limit. The circuit described here has been developed for use with a monitor that measures the concentration of tritiated water vapor in the air using a plastic scintillator flow counter.

29445 MULTICHANNEL INSTRUMENT FOR MEASURING THE TIME DISTRIBUTION OF PULSES. Kaul, B. V.; Mironchik, V. S.; Panov, Yu. A. (Scientific-Research Inst. for Nuclear Physics, Electronics, and Automation, Tomsk, USSR). Instrum. Exp. Tech. (USSR) (Engl Transl.); 18: No. 4, 1173-1174(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 134-135(1975).

A device is described for measurement of the rate of arrival of pulse flows as a function of time in the microsecond and millisecond range. The 34 channels of the instrument each have a capacity of 10^6 pulses and a resolution of 10 nsec. Data may be read directly from a digital display and read out to a printer, tape punch, or computer.

29446 TIME-AMPLITUDE CONVERTER HAVING A RESOLVING TIME APPROX. 10 PSEC. Danilevich, V. V.; Chernyavskii, A. F.; Yakushev, A. K. (Scientific-Research of Applied Physics Problems, Minsk). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1101-1104(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 79-82(1975).

Results are presented of the analysis of the metrological characteristics of a time-amplitude converter having a resolving time ~10 psec. The investigations were carried out in the range of variation of an analyzer-channel value of 10^{-11}–10^{-10} sec.

29447 NEW SMALL-ANGLE X-RAY SCATTERING FACILITY UTILIZING A ROTATING ANODE, PIN-HOLE COLLIMATION AND A POSITION-SENSITIVE PROPORTIONAL COUNTER. Schelten, J.; Hendricks, R. W. (Oak Ridge National Lab., TN). J. Appl. Crystallogr.; 8: 421-429(Aug 1975).

A new small-angle X-ray scattering facility which utilizes a 6 kW rotating anode, pin-hole collimation, and a position-sensitive proportional counter has been developed. As presently constructed, the minimum scattering vector k (equals 4 pi sin theta/lambda) which can be reached with Cu K alpha radiation is 5×10^{-3} A^{-1}. Under these conditions the flux incident on the specimen has been found to be 6×10^{5} photons s^{-1}. The system has several advantages compared with traditional long-slit geometries; namely, (i) it can quantitatively measure anisotropic scattering distributions, (ii) it avoids large mathematical corrections of the data for slit-smearing effects, and (iii) it minimizes double Bragg scattering in crystalline materials and multiple diffuse scattering in amorphous or liquid materials. To illustrate the performance of this instrument, the scattering curves obtained from four widely different samples are shown. These are: polyethylene, a neutron-irradiated aluminum single crystal containing voids, a dilute suspension of Ludox spheres, and duck tendon collagen. Quantitative comparisons of the performance with a Kratky camera and with the neutron small-angle scattering facility in Juelich are given. (auth)

29448 DISTRIBUTED COMPUTER INTELLIGENCE FOR DATA ACQUISITION AND CONTROL. Schoeffler, J. D. (Cleveland State Univ.); Rose, C. W. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 38-54(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The critical needs of nuclear science have motivated a trend toward distributed computer systems for data acquisition and control. Such systems combine the flexibility of distributed input/output systems with the capability of handling high data rates and critical control loops by localized intelligence and data reduction. Common problems of such systems such as data rate variations, analysis of alternative configurations, and utilization of standard modules are discussed. Emphasis is placed on the role of the microprocessor as a common component of the system. (61 references) (auth)

29449 TRIPLE-COINCIDENCE WITH AUTOMATIC CHANCE COINCIDENCE CORRECTION. Chase, R. L. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 244-246(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The chance coincidences in a triple-coincidence circuit are of two types—partially correlated and entirely uncorrelated. Their relative importance depends on source strength and source and detector geometry so that the total chance correction cannot, in general, be calculated. The system to be described makes use of several delays and straightforward integrated circuit logic to provide independent evaluation of the two components of the chance coincidence rate. (auth)

29450 METHOD FOR IMPLEMENTING MICROPROCESSOR-CONTROLLED SYSTEMS. Goodwin, R. W.; Kocanda, R. F.; Shea, M. F. (Fermi National Accelerator Lab., Batavia, IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 297-300(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Techniques for both hardware and software development of microprocessor systems are discussed. A cross-assembler, written for execution on a 16-bit control computer, is used to assemble programs and produce binary output tapes for programming read-only memories. A modular 8-bit microprocessor system has been developed that includes a bus-oriented card file and a group of analog and digital I/O interface cards. This has proved to be a flexible and inexpensive method of implementing a variety of one-of-a-kind microprocessor applications in a laboratory environment. (auth)

29451 ON-LINE HEAVY-WATER MONITORS BASED ON THE ABSORPTION OF INFRARED ENERGY. Allen, V. H.; Bayly, J. G. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 317-320(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Two types of infrared heavy-water monitors, designed for on-line use at CANDU nuclear power stations and at heavy-water production plants, are described. These monitors are capable of measuring excess concentrations of D_2O in H_2O (or H_2O in D_2O) to a few parts per million. Problems associated with changes in environmental conditions, such as temperature and water purity are discussed, together with methods used to reduce the effects of these changes. (auth)

29452 ULTRASONIC INSTRUMENT FOR CONTINUOUS MEASUREMENT OF SODIUM LEVELS IN FAST BREEDER REACTORS. Boehmer, L. S. (Westinghouse Hanford Co., Richland, WA); Smith, R. W. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 359-362(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

An ultrasonic level measurement system which provides a continuous digital readout over a range of 3 to 180 inches, was tested in 500°F liquid sodium. The system proved to be accurate and reliable, required no initial warm-up period and experienced no long term drift. Modifications can extend the present operating temperatures to greater than 1200°F. (auth)

29453 REJECTION OF RADIO-FREQUENCY NOISE WITH A WIDE-BAND DIFFERENTIAL PREAMPLIFIER AND SOLID-SHIELDED COAXIAL INPUT CABLES. Burns, R. S.; de Lorenzo, J. T. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 375-382(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Radio-frequency signals simulating electrical interference ranging from 50 kHz to 50 MHz were applied to the shields of the input cable system (two solid-shielded, mineral-insulated cables approximately 6 m long) of a wide-band (approximately 60 MHz) differential preamplifier for fission counters to determine the common-mode rejection. Results show that differences in electrical properties and shielding characteristics of the two input coaxial cables along with end effects produced by an unbalanced sensor severely degrade the rejection capability of the differential preamplifier. At 1 MHz, the common-mode rejection without input cables is approximately –70 dB; this is reduced to approximately –10 dB when measured with the rf signal applied to the surface of the input cable shields. Measurements of the shielding characteristics of the input cables showed resonances at test frequencies greater than 2 MHz. A ferrite core was installed in the input assembly to increase the impedance of the shields and to permit termination of the coaxial line consisting of the input cable shields and the protective metal conduit for the input cables. This assembly eliminated all resonances below 20 MHz. The increased impedance also reduced the amplitude of the shield currents, resulting in an increase in the shielding effectiveness of the input cables without affecting the signal transmission of the cables. (auth)

29454 AUTOMATIC PLANT DYNAMICS MONITORING SYSTEM. Thiele, A. W.; Pekrul, P. J.; Lewis, R. C.; Jencek, P. G. (Rockwell International Corp., Canoga Park, CA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 383-385(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A system has been developed for monitoring plant dynamic behavior using Power Spectral Density measurements. The data are taken and compared with frequency-dependent limits automatically under computer control. Historical data is maintained and is recallable by the operator for comparison with current data. (auth)

29455 LOGICAL AND PHYSICAL RESOURCE MANAGEMENT IN THE COMMON NODE OF A DISTRIBUTED FUNCTION LABORATORY COMPUTER NETWORK. Stubblefield, F. W. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 406-412(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A scheme for managing resources required for transaction processing in the common node of a distributed function computer system has been given. The scheme has been found to be satisfactory for all common node services provided so far. (auth)

29456 TASK SCHEDULER AND SERVICE SUBSYSTEM FOR THE COMMON NODE OF A DISTRIBUTED FUNCTION LABORATORY COMPUTER NETWORK. Stubblefield, F. W.; Dimmler, D. G. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 413-422(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

In a functionally distributed computer system, the system function is partitioned into less complex functions which reside at decreasing functional hierarchy levels. At some point in the partitioning process, all software and hardware required to implement an identified function are confined to a node of the system. The type of hardware elements and the form of the software required at the node are determined by the node function. This principle is illustrated in the case of a task scheduler for

the common node of a distributed function laboratory computer system having a star-like configuration. (auth)

29457 CONTINUOUS SHARING OF A RECORD-ORIENTED OUTPUT DEVICE WITHIN A DISTRIBUTED FUNCTION LABORATORY COMPUTER NETWORK. Stubblefield, F. W. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 423-430(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

An attempt to partition along functional lines a computer system for control of and data collection from a set of laboratory experiments leads to the notion of sharing of peripheral devices. Peripheral devices can be shared in two fundamentally different ways, reserved for discrete periods of time or continuously shared. The design and implementation of a subsystem to handle the continuous sharing of a record-oriented device is discussed. (auth)

29458 SOFTWARE SYSTEM FOR DATA ACQUISITION IN NUCLEAR PHYSICS EXPERIMENTS USING CAMAC. Minor, M. M.; Shlaer, S.; Thomas, R. F. Jr. (Los Alamos Scientific Lab., NM). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 459-461(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

An event-oriented, modular software system for data acquisition in nuclear physics experiments has been implemented on PDP-11 computers under the RSX-11D operating system. The system is designed to support high-speed data acquisition in a broad variety of nuclear physics experiments having multiple event types and using CAMAC instrumentation as the experimental interface. The system provides a simple, problem-oriented language for the specification of CAMAC operations to acquire data from each class of event. It provides automatic buffering of experimental data from the CAMAC hardware and recording on magnetic tape. Certain common utility functions are provided, especially histogram entries and plotting on on-line displays, along with associated operator control functions. The experimenter specializes the system to his needs by writing FORTRAN subroutines which specify necessary on-line analysis of data and control histogram entry. The software depends on a special event-trigger module which was designed in conjunction with the software and is used to identify the various different classes of events, to facilitate manual control and testing of an experiment, and to facilitate communication between different software modules in the system. (auth)

29459 SOFTWARE CONSIDERATIONS OF A MINICOMPUTER BASED MULTI-INSTRUMENT CAMAC AUTOMATION SYSTEM. Agrawal, A. K.; Butler, E. M. (Gould Labs., Rolling Meadows, IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 462-466(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A minicomputer based CAMAC automation system for simultaneous operation of independent analytical instruments is described. An approach to application software development in a real-time multi-user environment is discussed. The necessity of using queued I/O for the CAMAC branch driver is emphasized. Various techniques for efficient main memory management are also outlined. (auth)

29460 PSEUDO FAN BEAM RECONSTRUCTION ALGORITHMS AND THEIR RELATED PHYSICAL PROBLEMS. Cho, Z. H. (Univ. of California, Los Angeles); Tsai, C. M.; Ahn, I.; Wang, L.; Parsons, J. R. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 560-567 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The pseudo fan beam reconstruction algorithm and related physical problems are considered. Image distortion related to the rearrangement to a parallel beam from a fan beam scan is discussed together with physical problems such as Compton scattering in tissue which affects the final image quality.

29461 PROTON (AND OTHER HEAVY CHARGED PARTICLE) RADIOGRAPHY IN MEDICAL DIAGNOSIS. Steward, V. W. (Univ. of Chicago, IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 577-583(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Radiations other than those of the electromagnetic spectrum or of sound may be used for diagnosis. These consist of beams of sub-atomic particles, particularly of protons and heavy ions. With these beams radiographs of unusually high contrast are obtained for the visualization and differentiation of the body tissues at very low doses. The method is practical for use in hospitals and has potential for screening purposes.

29462 INSTRUMENT FOR BONE MINERAL MEASUREMENT USING A MICROPROCESSOR AS THE CONTROL AND ARITHMETIC ELEMENT. Alberi, J. L.; Hardy, W. H. II. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 645-650(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

We have developed a self-contained instrument for the determination of bone mineral content by photon absorptometry. A high-resolution detection system allows measurements to be made at up to 16 photon energies. Control and arithmetic functions are performed by a microprocessor. Analysis capability and limitations are discussed. (auth)

29463 BIO-SIGNAL PROCESSING USING DIGITAL TECHNIQUES. Patwardhan, P. K. (Bhabha Atomic Research Centre, Bombay); Misra, V. M.; Kumar, S.; Singh, B.; Shah, V. R.; Sundaram, K. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 662-666(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A simple digital technique is described which enables quick recording and analysis of bio-signals. Standard nuclear data acquisition techniques have been suitably adapted for on-line and off-line recording of bio-signals. A 1024-channel analyzer with 50 MHz analog-to-digital converter data acquisition system is used for on-line recording. The data obtained from the data acquisition system is processed for detailed feature selection, first by eliminating the extraneous noise by programmed digital filtering technique, by which the signals between 0 to 25 Hz are retained, 25 to 50 Hz are attenuated (transfer function varies from 1.0 to 0.0) and signals above 50 Hz are eliminated. The smoothened data are differentiated and stored. The results of two leads, I and II, as evaluated by this processing and as evaluated by a physician agreed well. The coefficient of correlation was 0.99, the slope of regression line was (0.9918 +- 0.03) and intercept for the same was (-0.0007 +- 0.0098). These results are presented and discussed.

29464 COMPUTER SYSTEM FOR ENVIRONMENTAL SAMPLE ANALYSIS AND DATA STORAGE AND ANALYSIS. Brauer, F. P.; Fager, J. E. (Battelle Pacific Northwest Labs., Richland, WA). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 743-747(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A mini-computer based environmental sample analysis and data storage system has been developed. The system is used for analytical data acquisition, computation, storage of analytical results, and tabulation of selected or derived results for data analysis, interpretation and reporting. This paper discussed the structure, performance and applications of the system. (auth)

29465 CONTROLLABLE AUTOMATED ENVIRONMENTAL DATA ACQUISITION AND MONITORING SYSTEM. Dimmler, D. G.; Greenlaw, N.; Rankowitz, S. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 748-756(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A real-time data acquisition and monitoring system was developed for coastal oceanographic parameter measurements. This system continuously measures profiles of temperature, conductivity, current velocity and direction as a function of depth at a number of fixed off-shore locations. The data acquisition, monitoring and control system features make this system generally suitable for unattended area monitoring applications. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 28973 and 29451.

29466 (IME-TN-2/75) A STUDY ON UTILIZATION OF A DISTILLATION COLUMN FOR RECONCENTRATION OF HEAVY WATER. Amaral, M. J. do; Coelho, J. C. M. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). Mar 1975. 12p. (In Portuguese). INIS.

The feed and product concentrations and flow rates have been determined in digital computer IBM-1130 by MacCabe Thiele method. The correlations for Good Loe packing and for heavy water vapor pressure have been developed from experimental data. The analysis of results shows that for obtaining a reasonable recuperation the feed flow rate should be extremely low; which would demand a very long time of operation with a little range of enrichment.

29467 (UCRL-Trans-11003) ISOTOPICALLY SELECTIVE IONIZATION BY INTERACTION OF THE MULTIPARTICLE TYPE. Forsen, H. K.; Levy, R. H.; Sargent Janes, G. Feb 1976. Translation of Belgian Patent No. 828,990. 30p. Dep. NTIS $4.00.

A method and an apparatus are claimed in the patent for inducing isotopically selective ionization by laser irradiation. The isotopically selective ionization is achieved in a preferred application to the enrichment of U, typically in the ^{235}U isotope, by exciting the ^{235}U, created in a medium comprising a U vapor stream, up to an energy level which is only slightly lower than the ionization level, and by using a collision ionization of particles to obtain ions of the desired isotope ^{235}U. (JSR)

29468 (UCRL-Trans-11005) ISOTOPE SEPARATION SYSTEM. Forsen, H. K. Feb 1976. Translation of Belgian Patent No. 823,889. 28p. Dep. NTIS $4.00.

This invention relates to the separation of isotopes and in particular to a magnetic separation system for ions selectively ionized by laser radiation. In this invention for the enrichment of ^{235}U isotopes the magnetic field is applied with a force which varies with time and which is synchronized with the repeated application of the laser radiations. (JSR)

29469 URANIUM ENRICHMENT. A Report of An Ad Hoc Forum Policy Committee. New York; Atomic Industrial Forum, Inc. (1972). vp. (NP-20829). $20.00.

The rate of separative work demand will exceed capacity on a free-world basis by the end of 1977, even if the combined capacity of the three U. S. gaseous diffusion plants is increased by more than 60 percent and European plans are implemented. To prevent a separative work shortage, a new large enrichment plant (8,750 MTSWU) should be brought into operation before the end of 1981 and another plant of the same size before the end of 1982. Plans should be initiated immediately. (DLC)

29470 IONOOPTICAL SCHEME OF TWO-STEP MASS-SEPARATION PLANT WITH MAGNETIC FIELDS OF r - 1 TYPE AND π RAD ANGLES OF DEFLECTION. Fedoseev, E. P. pp 579-585 of Isotope Production. Proceedings of the All-Union Scientific-Technological Conference 20 Years of Production and Application of Isotopes and Nuclear Radiation Sources in USSR National Economy, Held by the USSR State Committee for the Utilization of Atomic Energy, State Committee of the USSR Council of Ministers on Science and Technology at Minsk, October 1968. Mowcow; Atomizdat (1973). (In Russian)

From All-union scientific-technological conference 20 years of production and application of isotopes and nuclear radiation sources in USSR national economy; Minsk, Byelorussian SSR (Oct 1968). 5 figs.; 3 refs.

29471 ISOTOPE SEPARATION BY LASER RADIATION. Braunbek, W. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Atomkernenergie; 26: No. 4, 279-281 (1975). (In German)

2 figs.; 1 tab.; 8 refs.

A review is given of current experiments on separation or enrichment of isotopes by laser radiation. The strongly monochromatic radiation excites the atoms of only one of the isotopes or the molecules containing the isotope wanted. The excited atoms or molecules are separated by chemical reaction, or they are ionized by the photons of a second radiation, after which the ions are separated by an electric field. This method of isotope separation will eventually permit uranium enrichment on a cheaper and more energy-saving level. Actually, the efficiency of the method does not exceed a laboratory scale. (DE)

29472 GAS CENTRIFUGE. Tawara, H.; Sakurai, M. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 197,413,552/B/. 20 Mar 1970. 3p. (In Japanese).

The present invention relates to an apparatus which is used to centrifugally separate high mass number gases from low mass number gases. Four rotating cylinders are mounted in series on one rotating axle driven by an electric motor. The gas mixture is introduced through a coaxially provided tube into the center of each cylinder. Convection currents are produced in each cylinder by means of heat sources and heat sinks alternately disposed between cylinders and centrifugally separated gases are exhausted from orifices circumferentially disposed at the top and bottom plates of each cylinder, with the thus separated components withdrawn with a carrier gas. Since the rotating cylinders are disposed in series on the axle and are driven by a single motor, the number of bearings and drive motors is reduced significantly allowing a large power consumption reduction. Since a symmetrical temperature distribution results from the alternately disposed nature of the heat sources and the heat sinks, gas-seals between cylinders may be omitted due to the fact that the gases exhausted from orifices facing each other have the same composition. (INIS)

29473 PRODUCTION OF HEAVY WATER. Thayer, V. R. Canadian Patent 909482. 12 Sep 1972. 18p.

8 claims, 1 fig. Available from Commissioner of Patents, Ottawa.

Heavy water is concentrated by dual temperature exchange between hydrogen sulfide and water. The concentration is accomplished in a multi-stage system, utilizing process parameters requiring a higher temperature hot zone, a reduced recovery of the product from the feed water relative to the recovery theoretically possible, and limiting the increase in concentration per stage to a factor of less than 4. These operating parameters permit a substantial reduction in capital cost of the system. (auth)

29474 THEORY OF GASEOUS DIFFUSION SEPARATION: THE DIFFUSION CELL AND THE POROUS BARRIER. Massignon, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Chimie-Physique). Bull. Inf. Sci. Tech. (Paris); No. 206, 9-20(Sep 1975). (In French)

The theory of separation through homogeneous and multilayer barriers is developed for a binary gas mixture of arbitrary masses or molar fractions. (FR)

29475 METHOD OF JUDGING THE ENDURANCE PROPERTIES OF THE COMPONENTS OF A GASEOUS DIFFUSION PLANT. Bansard, J. P.; Delarousse, P. (CEA Centre de Pierrelatte, 26 (France)). Bull. Inf. Sci. Tech. (Paris); No. 206, 93-100(Sep 1975). (In French)

General methods of judging the endurance properties of materials are presented. The endurance of a material is characterized here by a mathematical concept known as the survival function, determined by the introduction of a model and the definition of certain notions such as the age and death of the material. A point estimate is reached, corresponding to the most probable survival function, and an estimate by confidence limits which assembles the most probable survival functions to a threshold corresponding to the confidence level required. An application at the Pierrelatte plant is described. (FR)

29476 CONTROL OF A GASEOUS DIFFUSION PLANT. Charlade, J.; Schrepel, R.; Simonet, M. (CEA Centre de Pierrelatte, 26 (France). Services de Production). Bull. Inf. Sci. Tech. (Paris); No. 206, 83-91(Sep 1975). (In French)

The procedure and organization of a gaseous diffusion plant is reviewed. A general description of the control method used with success for some years is given. It is found that due to the duration of start-up operations, the length of transients and the precautions to be taken in the event of stopping, a plant of this kind should be run continuously. However, during a period of operation the production can be varied owing to the flexibility of the assembly. The quality of production under permanent running conditions is maintained by the supervision of many parameters and by certain corrective operations and the structure of the assembly must be constant. Random deteriorations of equipment create perturbations of a more or less serious nature, the effects of which must be corrected. For the control, a centralization of the material facilities employed has been adopted. (FR)

29477 LARGE COMPONENTS FOR A GASEOUS DIFFUSION PLANT. Perrault, M.; Beraud, J. L.; Demay, R.; Lecluze, R.; Mezin, M.; Quenault, M. (CEA, 75 - Paris (France). Dept. des

Applications Industrielles de la Separation Isotopique). Bull. Inf. Sci. Tech. (Paris); No. 206, 49-66(Sep 1975). (In French)

The construction of a large size uranium enrichment plant involves series of several hundreds of components of unusual size and specifications. Together with French industry, the C.E.A., from the experience of construction and operation of the Pierrelatte plant, has developed large components for a gaseous diffusion plant based on the use of aluminium or nickel coated steel in a vertical stage set up. Compressors, converters, valves and heat exchangers, are large dimensions, high performances and a high degree of reliability. These components will be used in the Tricastin's plant which EURODIF has decided to build. (FR)

29478 METHOD FOR ESTIMATING THE ECONOMIC CHARACTERISTICS OF A URANIUM ENRICHMENT PLANT BY GASEOUS DIFFUSION. Berault, J. C. (Societe EURODIF, 92 - Bagneux (France)). Bull. Inf. Sci. Tech. (Paris); No. 206, 101-110 (Sep 1975). (In French)

To estimate the economic characteristics of a uranium enrichment plant by gaseous diffusion is to determine the prospective price of the separative work unit to which leads the concerned technology, and to collect the data allowing to ascertain that this price remains in the area of development of the prices forecasted by the other projects. The prospective price estimated by the promoter is the synthesis of the components of the go decision and which are a potential market and a comprehensive industrially proven plant design, including the basic economic and technical data of the project. Procedures for estimating these components and their synthesis, exclusive of financing problems are reviewed. (FR)

29479 TRICASTIN GASEOUS DIFFUSION PLANT. Ergalant, J.; Lebrun, C.; Leduc, C. (Societe EURODIF, 92 - Bagneux (France)); Perrault, M. (CEA, 75 - Paris (France). Dept. des Applications Industrielles de la Separation Isotopique). Bull. Inf. Sci. Tech. (Paris); No. 206, 111-134(Sep 1975). (In French)

The building of the EURODIF plant began just over a year ago. The documents on which this enterprise was based were already assembled, which allowed construction work to start without delay. A brief description of the equipment is given, together with an approach to the problems of planning and estimates. Mention is also made of running problems and those related to safety in operation. The present state of the project promises a successful outcome, regarding both the production start-up schedule and the respecting of the building estimate. (FR)

29480 INDUSTRIAL DEMONSTRATION TRIALS. Gelee, M.; Fabre, C.; de Villepoix, R.; Fra, J.; Le Foulgoc, L.; Morel, Y.; Querite, P.; Roques, R. (CEA Centre de Pierrelatte, 26 (France). Services Experimentation). Bull. Inf. Sci. Tech. (Paris); No. 206, 67-82(Sep 1975). (In French)

Prototypes of the plant components, meeting the specifications set by the process and built by industrial firms in collaboration with the supervisor and the C.E.A., are subjected to trial runs on the UF_6 test bench of the Pierrelatte testing zone. These items of equipment (diffuser, compressor, exchanger) are placed in an industrial operation context very similar to that of an enrichment plant. Their performance is measured within a broad region around the working point and their reliability observed over periods up to several tens of thousands of hours. Between 1969 and 1973 six industrial demonstration test benches have been built, marking the stages in the technical preparation of the 1973 file on the basis of which the decision of building was taken by Eurodif. (FR)

29481 SA PLANS R910m ENERGY PLANT. To the Point; 4: No. 20, 48(16 May 1975).

The commissioning of the first part of the R50 million Valindaba uranium enrichment project and confirmation of the economic viability of the milliard rand commercial plant are discussed. Attention is also given to the known world uranium deposits, demands and cost. (INIS)

29482 BREAK-THROUGH INVESTIGATION ON URANIUM ISOTOPE SEPARATION IN THE SYSTEM URANYL ION SOLUTION/Ti(III)-CATIONIC RESIN. Ponta, A.; Calusaru, A. Isotopenpraxis; 11: No. 12, 422-426(1975).

A break-through experiment on separation of uranium isotopes was carried out by use of a cation-exchange resin in Ti(III) form. By analyzing the experimental results the apparent equilibrium constants of the order $K = 1.00021-1.00034$ were determined. The maximum value on the experimental curves of the isotopic ratio versus effluent volume was interpreted by considering two antagonistic isotope effects: one relatively large one given by an exchange reaction between U(IV) in resin and U(VI) in solution and another smaller one given by the reduction reaction of U(VI) with Ti(III). The difference of the equilibrium constants of these two isotope effects as a function of temperature was used for the determination of the apparent thermodynamic values of the resultant process, determined experimentally: $\Delta H^\circ = 0.8542$ cal mol^{-1} and $\Delta S^\circ = 3.33 \times 10^{-3}$ cal $^\circ K^{-1}$.

29483 MULTIFREQUENCY RADIATION PRESSURE LASER, ISOTOPE SEPARATION. Bernhardt, A. F.; Duerre, D. E.; Simpson, J. R.; Wood, L. L. (Univ. of California, Livermore). Opt. Commun.; 16: No. 1, 169-171(Jan 1976).

Isotope separation by laser deflection of an atomic beam is limited in its efficiency by the accumulation of atoms in metastable states. This restriction can be removed with the use of lasers which excite metastable atoms to states from which spontaneous decay to the ground state is allowed. This is demonstrated in the separation of barium isotopes, where efficiency was improved from a lower limit of 70 percent to at least 83 percent using a second laser. Efficiency approaching 100 percent can be achieved in barium with a second laser but the required wavelength is not available.

29484 ENRICHMENT OF N^{15} BY CHEMICAL REACTIONS IN A GLOW DISCHARGE AT 77 °K. Manuccia, T.J.; Clark, M.D. (Laser Physics Branch, Optical Sciences Division, Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 28: No. 7, 372-374 (1 Apr 1976).

We have observed enrichments of N^{15} as large as $21 \pm 1\%$ in the mixed nitrogenous products (NO, N_2O, NO_2) of the reaction of N_2 and O_2 driven by a pulsed glow discharge at 77 °K. A typical energy expenditure per atom separated was 0.22 MeV. Enrichments increased but yields decreased as the electrical energy deposited per reactant molecule was reduced. Under similar conditions enrichment of 15% was observed for N^{15} from the reaction $N_2 + 3D_2 \rightarrow 2ND_3$. (auth)

29485 TWO-UP, ONE-DOWN IDEAL CASCADES FOR ISOTOPE SEPARATION. Olander, D. R. (Univ. of California, Berkeley). Nucl. Technol.; 29: No. 1, 108-112(Apr 1976).

The interstage flows are determined for an ideal isotope separation cascade in which the enriched stream from a stage is fed two stages up and the depleted stream is delivered to the next lower stage. It is shown that this type of cascade configuration is superior to the conventional ideal cascade if the separating power of the units comprising the cascade increases with decreasing cut. (auth)

Isotopic Power Sources

Refer also to abstract 30094.

29486 ENERGY SOURCES FOR MARINE TECHNOLOGY. Fischer, W. (Brown, Boveri und Cie A. G., Heidelberg (F. R. Germany). Zentrales Forschungslabor). VDI (Ver. Dtsch. Ing.) Z.; 117: No. 9, 415-421(May 1975). (In German)

5 tabs.; 4 figs.; 56 refs.

Energy sources for unmanned marine stations and manned underwater stations must satisfy numerous requirements. If one wants to judge which energy source should be used in a definite case of application, then it is necessary to valuate its properties according to given criteria. Thereby, the mass related to the energy content of an energy source and the costs related to the energy, which come up at the application of an energy supply system, may serve as measures. These costs due to the supply system do not comprise only the prime costs but also a share from the operating costs.

29487 COLD FUEL THERMIONIC CONVERTER. Dunlay, J. B.; Howard, R. C. (to Thermo Electron Corp.). US Patent 3,932,776. 9 Dec 1966. vp.

An energy conversion system is described comprising an externally insulated housing, a heat sink in the shape of an open-ended receptacle, a capsule of isotope fuel disposed in the heat sink and having a portion thereof extending beyond the heat sink being thermally insulated from the capsule and disposed in the housing to receive gamma radiation from the capsule. A heat utilization device is disposed in heat-transfer relationship to the heat sink for deriving heat therefrom. The housing including a portion thereof in a heat-transfer relationship with the portion of the capsule extends beyond the heat sink.

29488 GENERATION OF ELECTRICAL POWER. Hursen, T. F.; Kolenik, S. A.; Purdy, D. L. (to Arco Medical Products Co.). US Patent 3,944,438. 12 Aug 1971. Filed date 23 May 1969. vp.

A heat-to-electricity converter is described including a container bounded by a thermally conducting wall that has a heat source, a heat shield within the container enclosing the source, and a thermoelectric strip extending through the shield having a hot junction in heat-interchange relationship with the source and a cold junction in heat-interchange relationship with the wall, the only heat-conduction path through the strip from the hot junction

to the cold junction being longitudinal of the strip. The source is cylindrical having a base and the thermoelectric strip with a generally helical form with the hot junction at the inner end of the spiral and the cold junction at the outer end of the spiral. The hot junction end is in heat-exchange relationship with the source, the positioning of the strip in the container being such that any hypothetical radial line from the source to the wall intersects the strip only once. A gamma source is used and the heat-shield is composed substantially of tantalum.

29489 SCHOTTKY BARRIER BETAVOLTAIC BATTERY. Manasse, F. K. (Drexel Univ., Philadelphia); Pinajian, J. J.; Tse, A. N. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 860-870(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A new nuclear betavoltaic battery is described. It uses a Schottky barrier in place of the more standard p-n junction diode, along with ^{147}Pm metal film rather than Pm_2O_3 oxide as in the commercially available Betacel. Design details of the battery including measurement of absorption, conversion efficiency, thickness etc. as functions of resistivity and other cell parameters are described. A prototype design is discussed and its performance assessed. (auth)

Radiation Sources

Refer also to abstracts 29297 and 29356.

29490 CONTRIBUTION OF RADIATION SOURCES COST TO THE CAPITAL INVESTMENT WHEN BUILDING POWERFUL γ SOURCES. Guteev, V. P.; Osipov, V. B.; Terent'ev, B. M.; Sarapkin, I. I.; Ignatenko, V. G. pp No. 7 p.53-60 of Radiation Technology. Proceedings of VNIIRT. Moscow; Atomizdat (1972). (In Russian)

Design and Fabrication

29491 (JINR-R-3-8470) GAS AND FROZEN CONVERTERS AS ULTRACOLD NEUTRON SOURCES. Akhmetov, E. Z.; Kaipov, D. K.; Konks, V. A.; Golikov, V. V.; Strelkov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 28p. (In Russian). INIS.

29492 PREPARATION OF SOURCES FOR LIGHT MEASURING EQUIPMENTS. Murthy, T. S.; Cherian, S.; Ballaney, A. K.; Chinnayyan, C.; Kini, K. V. (Bhabha Atomic Research Centre, Trombay, India). pp 521-532 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

ZnS : Cu and ZnCdS : Cu type phosphors activated by beta-emitters like Pm-147 and tritium have been prepared for use as standard light sources for calibration of light measuring equipments. Preparation of the phosphor, effect of impurity concentration, temperature of crystallization and atmosphere during crystallization on the emission characteristics of the phosphor are reported. Light sources with emission in the range 500 to 600 mm and with total light output up to 50 microlamberts has been prepared with 20 mCi Pm-147 per gram of the phosphor. (auth)

29493 EQUIPMENT AND OPERATIONS FOR PREPARING ^{252}Cf NEUTRON SOURCES FOR INTERSTITIAL CANCER RADIOTHERAPY RESEARCH. Walker, V. W. (E. I. du Pont de Nemours and Co., Aiken, SC). Conf. Remote Syst. Technol., Proc.; 23: 3-10(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

Californium-252 medical source assemblies are fabricated with remotely operated equipment in the Medical Source Facility at the Savannah River Laboratory. All operations from the preparation of the clad wire to the fabrication of implant assemblies are performed with specially designed machines intended for production-type operation. The difficulties in handling objects that are as small as the core wire, 0.015 x 0.160 in., have required the development of new techniques, such as a miniature swager-drawbench, and the use of telephoto TV monitors to observe a capsule-loading operation.

Industrial Uses

29494 (INIS-mf-1879) UTILIZATION OF RADIOACTIVE TRACERS IN THE SEDIMENTARY STUDY OF THE RIO GRANDE (BRAZIL) SANDBAR. Aun, P. E.; Bandeira, J. V.; Marques, J. C.; Wilson Junior, G.; Maestrini, A. A.; Silveira, M. E. da; Fioravante Neto, A.; Campos, J. J. L. de; Silca Gomes, R. da; Silva, F. A. da. (Instituto de Pesquisas Radioativas, Belo Horizonte (Brazil). Divisao de Radioisotopos). 1973. 44p. (In Portuguese). INIS.

A radioactive tracer study is presented for the Rio Grande sandbar (Brazil). The radioactive tracer (1.5 Ci. of Iridium-192) was injected on Jan. 24, 1973,and followed by 3 detection campaigns: Jan. 24-Feb. 10, Mar. 19-Apr. 4, May 5-June 7. The scattering of the material on the bottom was followed by a detector, dragged over the bottom by a boat, which transports also the electronic equipment used. Some measurements were made also of current velocity and amplitude, wave direction and period.

29495 (INIS-mf-1923) STUDY OF GRINDING OPERATION USING RADIOACTIVE TRACERS. Aun, M. R.; Castro, J. O. N. M. (Instituto de Pesquisas Radioativas, Belo Horizonte (Brazil)). [nd]. 14p. INIS.

The complexity of the phenomena which takes place inside a mill as well as the irregularity of the particles of the material to be ground, originated the development of phenomenological models describing the behavior and characteristics of the system mill-charge in terms experimentally observable quantities without trying to explain their causes. A theory which actually describes the grinding process permitting the scientific design, control and optimization of grinding circuits is described.

29496 APPLICATION OF ISOTOPE MEASURING TECHNIQUES IN THE MOTOR CAR INDUSTRY. Sailer, S. (Daimler-Benz A. G., Stuttgart (F. R. Germany)). Materialpruefung; 17: No. 6, 165-167(Jun 1975). (In German)

4 figs.; 10 refs.

The article gives a survey on the most important isotope measuring techniques: ventilation measurements, oil consumption and wear measurements. In these methods as well as in all other isotope measuring techniques, many measuring and testing problems can be solved faster, more exactly, and thus more efficiently by proper and critical application. Many values can only be recorded by isotope measuring techniques. The constant use of these methods provides experience which leads to their constant improvement. (DE)

29497 METOD POVERKHNOSTNOI AKTIVATSII V PROMYSHLENNOSTI (METODIKI NORMATIVY I REKOMENDATSII). (Method of Surface Activation in Industry (Methods, Standards, and Recommendations)). Postnikova, V. I. (ed.). Moscow; Atomizdat (1975). 152p.

Studies on the wear of machine parts are beginning to be made by surface activation which makes it possible to measure the linear wear with high precision. The theoretical principles, practical recommendations, and standards necessary for the independent application of this method are discussed in detail. Extensive bibliographic material and studies by the author are used. Tests on the application of the method to different areas of machine fabrication are also discussed. (tr-auth)

29498 NEUTRON RADIOGRAPHY WITH ^{252}Cf IN FORENSIC SCIENCE. Cason, J. L. (Battelle-Northwest, Richland, WA). J. Forensic Sci.; 17: No. 1, 79-92(Jan 1972).

Equipment and methods for neutron radiographic examination of objects in forensic science are described. Examples discussed include booby-trapped ammunition, bomb in a matchbook, gun barrel analysis, narcotics in pen, and chemicals and metals in body tissue. (TFD)

29499 SOME APPLICATION POSSIBILITIES OF RADIOISOTOPE METHODS IN ELECTRONIC INDUSTRY. Walis, L. (Inst. Badan Jadrowych, Warsaw); Jaskolska, H.; Wronski, W.; Stverak, B. Radioisotopy; 16: No. 4, 529-580(1975). (In Czech)

Application possibilities of nuclear methods to the study of high-purity materials and of special technologies used in the electronics industry are described. Special attention is paid to neutron activation analysis, nuclear microanalysis of thin surface layers, autoradiography and radiotracer techniques. The most effective application fields of nuclear methods are indicated, e g., material purifying to semiconductor grade, doping of semiconductor materials by metallurgical techniques or by diffusion and implantation, investigations of the effect of material processing on the surface purity, studies of the metal-semiconductor reaction, dielectric layers etc. The advantages and disadvantages of the described methods and their sensitivities are discussed. The work is illustrated with a number of examples. (auth)

29500 GASEOUS DISCHARGE DISPLAY PANEL INCLUDING PILOT ELECTRODES AND RADIOACTIVE WIRE. Edwards, R. J.; Hairabedian, B. Z.; Poley, N. M. (to International Business Machines Corp.). US Patent 3,928,781. 23 Dec 1975. Filed date 3 Sep 1974. 4p.

In a plasma display panel consisting of gas enclosed between adjacent insulating members, a light source is used to supply

charged particles in the gas to permit firing of the gas when coordinate conductors identifying a site location are energized. The use of such pilot lamps facilitates ignition in firing with uniform selection and firing potentials within all sites of the display panel. To eliminate the difficulty in achieving firing during cold starts a radioactive source comprised of a copper wire electroplated with nickel 63 and overcoated with a protective coat of nickel is placed within the gas panel to provide a source of free electrons. The wire is held in place by friction against the inside walls of the panel. Since the wire emits only beta radiation, no radiation hazard exists externally to the panel.

29501 NUCLEAR ANALYTICAL CONTROL USING RADIOACTIVE TRACERS. Tolgyessy, J. pp 368-395 of Radiotracer Method in Practical Work. Akerman, K. Bratislava; ALFA (Dec 1972). (In Slovak)

Addendum to the translation of "Technicne zastosowanie metody atomow znaczonych," Warsaw, 1970.

A survey is listed of nuclear analytical methods suitable for the analytical control of technological processes using radiotracers. The principle and the applications are described of analysis based on natural radioactivity measurement, of radiometric titrations, isotope dilution analysis, radioreagent methods, and activation analysis. (INIS)

29502 SEPARATION PROCESSES. Akerman, K. pp 168-199 of Radiotracer Method in Practical Work. Bratislava; ALFA (Dec 1972). (In Slovak)

Pages 7-367-translation of "Techniczne zastosowanie metody atomow znaczonych," Warsaw, 1970.

The application is described of radiotracers in the investigation of industrial separation processes, such as distillation, extraction, filtration, precipitation, and crystallization. (INIS)

29503 MEASUREMENT OF QUANTITY OF SUBSTANCES. Akerman, K. pp 142-149 of Radiotracer Method in Practical Work. Bratislava; ALFA (Dec 1972). (In Slovak)

Pages 7-367-translation of "Techniczne zastosowanie metody atomow znaczonych," Warsaw, 1970.

The application of radiotracers is described in the determination of the amount of substances present in natural or in industrial processes. (BS)

29504 HOMOGENIZATION PROCESSES. Akerman, K. pp 150-167 of Radiotracer Method in Practical Work. Bratislava; ALFA (Dec 1972). (In Slovak)

Pages 7-367-translation of "Techniczne zastosowanie metody atomow znaczonych," Warsaw, 1970.

The application of radiotracers in industrial homogenization processes is described. (BS)

29505 WEAR AND IDENTIFICATION OF MATERIALS. Akerman, K. pp 200-252 of Radiotracer Method in Practical Work. Bratislava; ALFA (Dec 1972). (In Slovak)

Pages 7-367-translation of "Techniczne zastosowanie metody atomow znaczonych," Warsaw, 1970.

The application is described of radiotracers in the determination of wear of materials and industrial equipment due to abrasion, erosion, corrosion, etc., and in the labelling of materials and articles for identification purposes. (BS)

29506 LEAK TESTING. Akerman, K. pp 253-263 of Radiotracer Method in Practical Work. Bratislava; ALFA (Dec 1972). (In Slovak)

Pages 7-367-translation of "Techniczne zastosowanie metody atomow znaczonych," Warsaw, 1970.

The application is described of radiotracers in the determination and localization of leaks in pipings, gas holders, water reservoirs, telephone cables, semiconductors, etc.

29507 GENERAL. Akerman, K. pp 339-367 of Radiotracer Method in Practical Work. Bratislava; ALFA (Dec 1972). (In Slovak)

Pages 7-367-translation of "Techniczne zastosowanie metody atomow znaczonych," Warsaw, 1970.

The selection of a radiotracer and its chemical form is discussed with a view to the phenomenon or process to be investigated. Listed are the most commonly used radionuclides, their half-lives, technologically important radiation, and chemical form suitable for investigation in aqueous solutions and organic and solid substances. Some devices serving the addition of radiotracers and the sampling are described.

29508 THE CALCULATION OF PARAMETERS OF THE FINISHING PROCESSES OF GLASS FIBER FABRICS BY THE MEANS ON THE BASIS OF ISOTOPE INVESTIGATIONS. Filipiak, R.; Kulakowski, B. (Instytut Szkla, Warsaw (Poland)). Szklo Ceram.; 24: No. 5, 129-132(1973). (In Polish)

The method of calculations by the means of digital computer as well as the results are presented. The accuracy of the results are discussed.

29509 THE ELECTROLYTE MIGRATION IN THE GYPSUM MOULDS-ISOTOPE MEASUREMENTS. Kiwinska, M. (Instytut Szkla, Warsaw (Poland)). Szklo Ceram.; 24: No. 12, 354-360 (1973). (In Polish)

The isotopic tracer method (^{24}Na) has been used for the determination of concentration variations (water, glass) of electrolytes migrating with water in the gypsum moulds during the casting. The technique of thin layers separation was applied. The investigations were made on the model moulds. The conclusions concerning the wear of casting moulds are presented.

29510 FLOW OF SOLIDS, LIQUIDS AND GASES. Akerman, K. pp 62-141 of Radiotracer Method in Practical Work. Bratislava; ALFA (Dec 1972). (In Slovak)

Pages 7-367-translation of "Techniczne zastosowanie metody atomow znaczonych," Warsaw, 1970.

Radiotracers and their applications in the investigation of solid, liquid and gas flows are described. Examples are given of the measurement of the flow of liquids and gases in industrial facilities.

29511 CENTRAL INSTITUTE OF ISOTOPE AND RADIATION RESEARCH OF THE ACADEMY OF SCIENCES OF THE GDR. Wetzel, K.; Leonhardt, J.; Gerstenberger, H. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Kernenergie; 18: No. 7, 201-206(1975). (In German)

A brief review is given of the history of evolution, the most important recent and future research problems of, as well as some essential results from the Central Institute for Nuclear Research of the Academy of Sciences of the GDR in Rossendorf. (GC)

29512 FIFTH ^{252}Cf UTILIZATION MEETING SHOWS: ^{252}Cf APPLICATIONS BECOMING MORE DIVERSIFIED. Californium-252 Prog.; No. 20, 3-7(Jan 1976).

From 5th ^{252}Cf utilization meeting; San Diego, CA, USA (4 Nov 1975).

Topics discussed under separate sections include: radiotherapy-radiobiological studies with ^{252}Cf; protection and dosimetry of ^{252}Cf radiations for implant therapy; clinical experience with ^{252}Cf; neutron dosimetry-fission neutron dosimetry; response of thermoluminescent dosimeters to ^{252}Cf; natural resources exploration-uranium exploration using ^{252}Cf; uranium borehole logging using ^{252}Cf; measuring thermal neutron absorption cross sections of formation brines; pollution control-determining trace elements in the Mahoning River System; process control-neutron activation analysis with ^{252}Cf at Kodak; analysis of coal with ^{252}Cf; on-line analysis of foundary sands; determining of bromine in polystyrene and polyethylene; continuous on-line hafnium monitor; neutron activation analysis-determining sodium and manganese in rock samples; determining content of wood; neutron gaging-determining gadolinium in fuel pellets; and neutron radiography-detection of adhesive bond-line flaws by neutron radiography. The Fifth ^{252}Cf Utilization Meeting held in San Diego on Nov. 4–6, 1975 is briefly reviewed. (TFD)

29513 RADIOISOTOPES IN PESTICIDE RESEARCH. Part VI. Review Papers, General Methods of Analysis, Insecticides. Dedek, W. Isotopenpraxis; 11: No. 11, 378-385(1975).

The preceding reviews of literature from 1964, 1967, and 1970 are continued. Mainly papers from 1970 to 1974 are reported. Investigations about labelled substrates are not referred to.

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 28432, 29296, and 29304.

29514 (COO-3276-20(82)) ULTRAVIOLET IRRADIATION OF NUCLEIC ACIDS AND RELATED COMPOUNDS. Final Progress Report. Wang, S. Y. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1976. Contract E(11-1)-3276. 30p. Dep. NTIS $4.00.

Progress is reported on the following research projects: photohydration of pyrimidine derivatives; thymine dimerization; uv-induced formation of pyrimidinyl radicals; formation of a coupled product by irradiation of 5-bromouracil derivatives; studies of pyrimidine adducts; molecular aggregates-puddle formation hypothesis of pyrimidine photodimerization; and topochemical studies of structures of dimers and of crystalline arrangements. (HLW)

29515 (IAEA-R-1329F) INFLUENCE OF GAMMA-IRRADIATION ON THE PROVITAMIN A, BETA-CAROTENE AND RELATED CAROTENOIDS IN MODEL SYSTEMS AND FOOD PRODUCTS. Final Report for the period 1 December 1972-30 June 1974. Maes, E.; Snauwaert, F.; Tobback, P. (International Atomic Energy Agency, Vienna (Austria)). Aug 1974. 190p. INIS.

With the objective of understanding the mechanism of the influence of gamma irradiation on the carotenoids in brown shrimp (Crangon vulgaris Fabr.), the effect of gamma irradiation on provitamin A, beta-carotene, and related carotenoids in model systems was investigated. Beta-carotene was irradiated at doses up to 1.5 Mrad in crystalline form or freely dissolved in nonpolar or polar solvents. The effect of irradiation on the water soluble carotenoproteins in the food products was simulated in the model system in which beta-carotene and canthaxanthine were adsorbed to albumin. The carotenoid stability during radurization of the brown shrimp, both boiled and unboiled, was investigated. The boiled shrimps were irradiated with doses varying from 50-300 krad. The unboiled shrimps were irradiated at doses up to 350 krad. In comparison, salmon samples were irradiated at 300 krad and subjected to the carotenoid analyses as in the case of shrimps. No breakdown of the carotenoid molecule could be detected when irradiating crystalline beta-carotene and canthaxanthine with doses up to 1.5 Mrad. Irradiating beta-carotene in organic solvents revealed that the carotenoid concentrations, the nature of the solvent and the radiation doses are three important factors determining the radiation sensitivity of beta-carotene. Irradiation of beta-carotene in the presence of radical donours resulted in the increased radiation sensitivity of beta-carotene. Irradiation of carotenoproteins at 500 krad resulted in the production of H_2S. Increasing viscosity of the carotenoprotein solutions was observed as a function of the dose. Although losses of extractable pigments of irradiated boiled shrimp during storage were detected, no noticeable visual discolouration was observed on the pigment. No degradation product was found in the pigment content of irradiated samples upon analysis by TLC. No loss of pigment content of irradiated unboiled shrimp was found both quantitatively and qualitatively. In comparison, high loss of astaxanthine content occurred when irradiating salmon samples, as the astaxanthine and its esters in a salmon species are not bound to proteins as in the case of shrimps. It was clearly shown that changes in colour will certainly not be the limiting factor when radurizing shrimps. (INIS)

29516 (INIS-mf-1969) RADIATION HEALTH AND SAFETY. Annual Report for the Year Ended 31st December 1974. Rosen, R. (New South Wales Univ., Kensington (Australia)). 1975. 14p. INIS.

Radiation protection procedures are outlined and an account is given of radiation incidents during the year. Personnel monitoring and disposal of radioactive waste are briefly described.

29517 (ORNL-5111, pp 93-95) BIOPHYSICAL CHEMISTRY. Feb 1976.

In Chemistry Division annual progress report for period ending November 1, 1975. (Oak Ridge National Lab., Tenn. (USA)).

Studies on singlet excitation transfer from polyriboadenylic acid (poly rA) to bound dye at 77°K are reported. Progress in the development of a theory of excited-state interactions in biomolecular aggregates is noted. (JGB)

29518 (SGAE-2362) INFLUENCE OF NAPROXEN ON DNA-SYNTHESIS AND DNA-REPAIR IN HUMAN LYMPHOCYTES. Klein, G.; Wottawa, A.; Streit, S.; Altmann, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Mar 1974. 4p. (In German). (BL-118/74). INIS.

To be publ. in Z. Arzneimittelforschg.

The effect of 2-(6'-methoxy-2'naphthyl)-propionic acid (naproxen, CG 3117) on semiconservative DNA-synthesis and DNA-repair in human lymphocytes was investigated. It was shown that there was no inhibition of DNA-synthesis and only a slight decrease in the repair capacity. (auth)

29519 INDIVIDUAL RADIATION CONTROL ON THE TERRITORY ON THE BULGARIAN NUCLEAR RESEARCH INSTITUTE FOR THE PERIOD 1962-1972. Khristova, M.; Mishev, I. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). Rentgenol. Radiol.; 13: No. 4, 202-208 (1974). (In Bulgarian)

Results are reported of systematic measurements of the individual doses received of associates working within the sphere of ionizing radiation on the territory of the Nuclear Research Institute at the Bulgarian Academy of Sciences for the period 1962-1972. Individual radiation control was performed by use of ionizing camera type DK-02 of dosimeters and photodosimeters. Gamma rays, β rays, and heat neutrons are kept under control with the help of a plate holder constructed at the Institute. The analysis of the results of individual irradiation showed that the maximal annual dose received by any employee during the entire 10 year period does not exceed 0.2 maximal admissible dose. The annual dose is usually less than 0.1 maximal admissible dose. Cases of irradiation with a dose higher than the maximal admissible annual dose have not been recorded. (auth)

29520 RADIATION-INDUCED ALDEHYDES IN COLLAGEN. Jelenska, M. M.; Dancewicz, A. M.; Przygoda, E. (Inst. of Nuclear Research, Warsaw). Acta Biochim. Pol.; 22: No. 2, 179-183(1975).

Aldehydes present in native and irradiated (30 krad) collagen were separated from its enzymic degradation products using molecular-sieve chromatography on Bio-Gel P-2 column. From the absorption spectra of N-methylbenzothiazolone hydrazone derivatives it was concluded that two out of five of the aldehydes separated from the irradiated collagen were identical with those present in control collagen. The possible origin of three other aldehydes is discussed. (auth)

29521 HYDRODYNAMIC PROPERTIES OF THE DNA OF ESCHERICHIA COLI STRAINS, DIFFERING IN THEIR RADIOSENSITIVITIES, AND THE MATRIX SYNTHESIS OF RNA IN VITRO. Barenfel'd, L. S.; Barskaya, T. V. (Inst. of Cytology, Leningrad). Dokl. Akad. Nauk SSSR; 221: No. 6, 1444-1447(21 Apr 1975). (In Russian)

Data are presented to show that the reduction of the matrix activity of the DNA of the radioresistant strain of E. coli B/r depends on the irradiation dose. Although the matrix activity of the DNA of E. coli is almost completely reduced as a result of the incubation of bacteria after irradiation at a dose of 10 kR, it is impossible to exclude the fact that the number and length of the chains as well as the composition of the base of the re-synthesized RNA was changed. On the basis of the data obtained it can be assumed that the reparation of DNA after irradiation of this strain of E. coli at a dose of 20 kR does not restore the structure of DNA to its pre-alteration state. (JSR)

29522 EXCISION REPAIR OF ULTRAVIOLET-IRRADIATED DEOXYRIBONUCLEIC ACID IN PLASMOLYZED CELLS OF ESCHERICHIA COLI. Seeberg, E. (Norwegian Defense Research Establishment, Kjeller); Strike, P. J. Bacteriol.; 125: No. 3, 787-795(Mar 1976).

A system of cells made permeable by treatment with high concentrations of sucrose (plasmolysis) has been exploited to study the excision repair of ultraviolet-irradiated deoxyribonucleic acid in Escherichia coli. It is demonstrated that adenosine 5'-triphosphate is required for incision breaks to be made in the bacterial chromosome as well as in covalently closed bacteriophage lambda deoxyribonucleic acid. After plasmolysis, uvrC mutant strains appear as defective in the incision step as the uvrA-mutated strains. This is in contrast to the situation in intact cells where uvrC mutants accumulate single-strand breaks during postirradiation incubation. These observations have led to the proposal of a model for excision repair, in which the ultraviolet-specific endonuclease, coded for by the uvrA and uvrB genes, exists in a complex with the uvrC gene product. The complex is responsible for the incision and possibly also the excision steps of repair. The dark-repair inhibitors acriflavine and caffeine are both shown to interfere with the action of the adenosine 5'-triphosphate-dependent enzyme. (auth)

29523 PRESENCE OF AN ENDONUCLEASE ACTING ON UV-IRRADIATED AND DEPURINIZED DNA IN CELLS OF MICRO-

COCCUS LYSODEIKTICUS. Tomilin, N. V. (Inst. of Cytology, Leningrad). Mol. Biol. (USSR) (Engl. Transl.); 8: No. 4, 444-453 (1974).

Enzymatic activity, hydrolyzing DNA treated with beta-isopropyl-bis-beta-chloroethylamine (HN_2-DNA), HN_2-DNA exposed at 50° for 1 hr, and DNA treated with acid, to acid-soluble fragments was found in extracts from cells of M. lysodeikticus. The endonucleolytic component of the indicated activity manifests chromatographic properties on DEAE- and CM-cellulose, close to those for UV-endonuclease. Activity is manifested by UV-irradiated DNA, proflavin, and cyanide. Two electrophoretically homogeneous fractions of UV-endonuclease (after chromatography on DEAE- and CM-cellulose), with molecular weights about 13,000 and 15,000 daltons, exhibit endonucleolytic activity with respect to HN_2-DNA, exposed at 50° for 1 h, and with respect to "acid" DNA, treated for 6 min at 70° in citrate buffer, pH 3.5. The activity with respect to the latter substrate is competitively suppressed by UV-irradiated DNA. The most probable substrate of UV-endonuclease, in addition to cyclobutane dimers, is the depurinized region of DNA. (auth)

29524 TWO PHOTO-CROSS-LINKED COMPLEXES OF ISOLEUCINE SPECIFIC TRANSFER RIBONUCLEIC ACID WITH AMINOACYL TRANSFER RIBONUCLEIC ACID SYNTHETASES. Budzik, G. P.; Lam, S. S. M.; Schoemaker, H. J. P.; Schimmel, P. R. (Massachusetts Inst. of Tech., Cambridge). J. Biol. Chem.; 250: No. 12, 4433-4439(25 Jun 1975).

Escherichia coli Ile-tRNA synthetase and tRNA/sup Ile/ have been cross-linked photochemically by the direct action of ultraviolet light. In addition, photo-induced joining of tRNA/sub E. coli//sup Ile/ to Val-tRNA synthetase from yeast has also been achieved. This yeast enzyme is known to mischarge E. coli tRNA/sup Ile/ with valine. Regions on tRNA/sup Ile/ involved in cross-linking have been determined for both complexes. In each case, three distinct parts of the nucleic acid are found cross-linked. Two of these are the same in both complexes and involve the dihydrouridine stem and loop region. The third part is unique for each complex. It involves the 3' terminus in the cognate one and the 3' side of the anticodon in the non-cognate case. When the cross-linked regions are projected onto a model of the three-dimensional structure of tRNA, it is clear that these and other data are consistent with having each enzyme bound in a similar orientation across tRNA/sup Ile/. The enzymes are viewed as spanning the distance from the anticodon to the 3' terminus and making extensive contact with the area in which the two helical branches of the L-shape tRNA structure come together. (auth)

29525 ABSENCE OF SPECIFICITY IN INHIBITION OF DNA REPAIR REPLICATION BY DNA-BINDING AGENTS, COCARCINOGENS, AND STEROIDS IN HUMAN CELLS. Cleaver, J. E.; Painter, R. B. (Univ. of California, San Francisco). Cancer Res.; 35: No. 7, 1773-1778(July 1975).

Although many chemicals, including cocarcinogens, DNA-binding agents, and steroids, inhibit repair replication of ultraviolet-induced damage to DNA in human lymphocytes and proliferating cells in culture, none of these chemicals is specific. Our results show that all the chemicals we tested inhibit normal DNA synthesis as much as or more than they inhibit repair replication. There is thus no evidence in our results to support the hypothesis that cocarcinogens are specific inhibitors of DNA repair or that any of the chemicals studied might be useful adjuncts to tumor therapy merely because of specific inhibition of radiation repair mechanisms. (auth)

29526 INACTIVATION OF CATALASE MONOLAYERS BY IRRADIATION WITH 100 keV ELECTRONS. Hahn, M.; Seredynski, J.; Baumeister, W. (Univ., Duesseldorf). Proc. Natl. Acad. Sci. U. S. A.; 73: No. 3, 823-827(Mar 1976).

A catalase monolayer adsorbed on a layer of arachidic acid deposited on a solid support was irradiated with 100 keV electrons simulating the conditions of electron microscopic imaging. Effective doses were calculated taking into account the angular and energy distribution of backscattered electrons. Enzymatic inactivation was chosen as the criterion for damage and was monitored by a rapid and quantifiable but nevertheless sensitive assay. Dose-response curves revealed that inactivation is a one-hit-multiple-target phenomenon, which is consistent with biochemical evidence for a cooperative function of subunits. The experimentally determined target size coincides fairly well with both calculated cross sections for inelastic interactions based on the atomic composition of catalase and with calculated cross sections for ionizing events based on the chemical bonds involved. This legitimates both types of calculations even for complex biomolecules.

29527 CHEMICAL AND CONFORMATIONAL STUDIES OF GAMMA-IRRADIATED SOLID LYSOZYME. Herbert, S. M.; Tolbert, B. M. (Univ. of Colorado, Boulder). Radiat. Res.; 65: No. 2, 268-282(Feb 1976).

From 17th annual meeting of the Radiation Research Society; Cincinnati, OH, USA (18 May 1969).

Gamma-irradiated solid lysozyme was separated by cation exchange chromatography with a phosphate buffer into a number of components. The chemical and physical properties of the major fraction, P3-I, were examined in detail. This material elutes very close to the native enzyme, is stable, and is chromatographically homogeneous. It has 94 percent of the native enzyme activity. Absorption spectra, heat and pH denaturation studies, sedimentation velocity, and disc gel electrophoresis all showed that P3-I differed from native lysozyme. Data indicated that P3-I had an altered shape and exhibited both reversible and irreversible conformational damage. Experiments labeling the irradiated lysozyme with HTS showed that P3-I had suffered comparable chemical damage by this criterion as the more heavily damaged fractions. These results indicate that in P3-I, and therefore in the whole irradiated enzyme, most of the molecules have suffered some radiation damage. The results are in direct conflict with classical target theory where a "hit" or ionization constitutes an inactivation. (auth)

29528 INVOLVEMENT OF AROMATIC AMINO ACIDS IN BIOLOGICAL ACTIVITY OF BOVINE FIBRINOGEN AS ASSESSED BY GAMMA-IRRADIATION. Chanderkar, L. P.; Gurnani, S.; Nadkarni, G. B. (Bhabha Atomic Research Centre, Trombay, India). Radiat. Res.; 65: No. 2, 283-291(Feb 1976).

Purified bovine fibrinogen in aqueous solution (1 mg/ml) was subjected to gamma-irradiation (0-100 kR) in the presence and absence of free radical scavengers. The absorption and emission spectra along with the data on amino acid composition indicated loss of tryptophan and tyrosine residues in the protein concomitant with the dose of radiation exposure. This could be correlated with the decrease in clottability of fibrinogen and the increase in clotting time. Sodium nitrate, an electron scavenger, did not exert protective action, either on these amino acids or on the biological activity of the protein as the substrate of thrombin. On the other hand, potassium iodide, a scavenger of OH· radicals preserved both of these to the extent of 90-95 percent. The results suggest that aromatic residues have a role in the clotting function of bovine fibrinogen and that gamma-radiation could serve as a probe to ascertain their involvement in the biological integrity of nonenzyme proteins. (auth)

29529 CHANGES IN THE ENZYMATIC ACTIVITY OF RENNIN DIFFERENT PURITY SAMPLES UNDER THE INFLUENCE OF GAMMA ^{60}Co IRRADIATION. Bachman, S.; Borkowska, M. (Politechnika Lodzka (Poland). Instytut Techniki Radiacyne)). Rocz. Technol. Chem. Zywn.; 22: No. 2, 121-128(1972). (In Polish).

The purpose of this work was to study the influence of irradiation using doses from 0.5 to 20 Mrad on the enzymatic acitivty of rennin protein. The samples were irradiated at room temperature in the solid state (freeze dried), not deaerated, in radiation chamber ^{60}Co at about 20 kC activity. The industrially produced rennin was purified by the dialysis method and fractionation on the sephadex gel G-75 (Pharmacia). It was found that purification increases the susceptibility of the industrially produced rennin to irradiation. Decrease of activity for the 1 Mrad dose after dialysis was 5%, after filtration with sephadex gel was 30% for the same dose. The molecular weight of the Polish made preparation of rennin estimated by means of molecular filtration was 42,000-44,000. Besides this enzymatically active part of the preparation there were some other fractions of 88,000 or 20,000 molecular weight. These compounds are probably dimers and subunits of rennin which should be confirmed in further studies. The obtained results confirm the high resistance of enzyme to the irradiation, especially in the biological systems. They broaden the knowledge about the influence of irradiation on the enzyme protein. The results also confirm the usefulness of the irradiation method for the sterilization of the industrial preparation. (auth)

29530 DARK REPAIR OF UV-INDUCED LESIONS IN BACTERIAL DNA. Kopff, M.; Kopff, J.; Kanski, M. (Wojskowa Akademia Medyczna, Lodz (Poland)). Postepy Mikrobiol.; 13: No. 1, 57-66(1974). (In Polish).

The mechanism of photochemical reaction resulting in the formation of pyrimidine base dimers in DNA is briefly described. Many bacterial species are able to excise the fragments of single-stranded DNA containing pyrimidine dimers, and to rebuild the lacking oligonucleotide fragment. Enzyme system acting in the restitution of damaged DNA to its native form is reviewed. (auth)

29531 STUDIES OF RADIOLYSIS OF COLISTIN SULFATE. Achmatowicz-Szmajke, T.; Bryl-Sandelewska, T.; Blum, A.; Witkowska, K. Acta Pol. Pharm.; 32: No. 1, 107-112(1975). (In Polish)

Effects of γ irradiation of colistin sulphate in the solid state were investigated. Formation of some volatile products and functional groups reacting with 2,4-dinitrophenylhydrazine has

been demonstrated. On absorption of the dose of 2.5 Mrads, the biological activity of colistin sulphate was found to decrease by some 6%. (auth)

29532 EFFECTS OF ^{60}Co γ IRRADIATION ON CHLORAMPHENICOL SUCCINATE MONOSODIUM SALT. Achmatowicz-Szmajke, T.; Blum, A.; Stuglik, T.; Witkowska, K. Acta Pol. Pharm.; 32: No. 1, 101-105(1975). (In Polish)

Relatively high resistance of chloramphenicol succinate monosodium salt to γ irradiation has been established. The observed changes indicate that the succinate moiety is mainly affected. (auth)

29533 CARBON TETRACHLORIDE AND BIOLOGICAL DAMAGE: PULSE RADIOLYSIS STUDIES OF ASSOCIATED FREE RADICAL REACTIONS. Willson, R. L.; Slater, T. F. (Brunel Univ., Uxbridge, Eng.). pp 147-161 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

A series of experiments using the technique of pulse radiolysis were undertaken to investigate the detailed chemical reactions through which carbon tetrachloride exerts its toxic effect on man. Furthermore, the reactions of CCl_3. and related radicals with compounds known to protect liver against CCl_4 induced damage can be investigated. As examples of molecules of biological interest, tryptophan and tyrosine and ribonuclease were selected. Some phenothiazine derivatives are the best protectors of liver damage known to date, and the reactions of promethazine and chloropromazine were therefore investigated. Experimental techniques are presented, and the results are discussed. Further possibilities of using the method are considered. (UK)

29534 CHEMISTRY OF PEROXY RADICALS AND ITS APPLICATION TO RADIATION BIOLOGY. Simic, M. (Univ. of Texas, Austin). pp 162-179 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

A review is presented of peroxy radical chemistry and its implication for radiation biology, using the techniques of pulse and steady-state radiolysis. The subject is dealt with in sections, entitled: electron transfer reactions from free radicals; the superoxide radical $.O_2^-$; formation and detection of organic peroxy radicals; acid-base properties of peroxy radicals; stability of organic peroxy radicals; reactions of electron adducts and O_2; slow reactions of radicals and oxygen; decay kinetics of peroxy radicals; intermediates of peroxy radical reactions; formation of hydroperoxides; peroxy radicals and molecular radiation biology; lethality in presence of oxygen; repair of damage. (UK)

29535 PULSE RADIOLYSIS INVESTIGATION OF THE INTERACTIONS OF DRUGS AND DYES WITH MACROMOLECULES AND RIBOSOMES. Phillips, G. O. (Univ. of Salford, Eng.); Power, D. M.; Davies, J. V. pp 180-192 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

The reactions of hydrated electrons produced during pulse radiolysis have been utilized to investigate the binding of eleven penicillins and four cephalosporins to bovine serum albumin. A primary binding site exists in the serum albumin molecule, which results indicate to be a hydrophobic cleft in the surface of the molecule separated by a distance > 0.5 nm from a cationic amino acid residue, probably lysine. Interaction of drugs with this binding site leads to a conformational change in the protein resulting in a decrease in reactivity towards hydrated electrons. Interaction of cephalosporin C and 6-amino penicillanic acid with serum albumin involves another site which consists of a cationic amino acid residue separated from anionic residue by a distance >0.7 nm. Drug binding at this site induces a conformational change in serum albumin leading to greatly increased reactivity towards hydrated electrons. This increase is associated with an increased availability of disulphide bridges. Cephalosporin C also binds hydrophobically to serum albumin resulting in a decrease in reactivity towards e_{aq}^-; such binding can be prevented by palmitic acid. Recent data clearly indicate that the pulse radiolysis technique can be further extended to investigate the nature of the interactions of bacterial ribosome suspensions with amino-acridines. Ion binding between benzoflavine and ribosomes has been examined over a wide temperature range and the thermodynamic parameters governing the interaction have been evaluated. (auth)

29536 DYNAMICS OF PYRENE FLUORESCENCE IN MICELLES AND MEMBRANE VESICLES. Cheng, S.; Graetzel, M.; Thomas, J. K.; Kulpa, C. F. (Univ. of Notre Dame, IN). pp 193-211 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

The kinetic motion of various species of interest to radiation chemists and biologists, for example H atoms, solvated electrons, etc, into micelles has been investigated by pulsed radiolysis techniques. The various factors, such as ionic charge on the micelle, which affect the entry of the reactive probes have been investigated. In addition, the kinetic motion of various stable probes such as iodide ion, triethylamine and various arenes, have been studied both into the micelle, within the micelle, and exiting from the micelle. Here pulsed laser techniques have been used specifically to excite regions of the micelle. The above techniques have been successfully applied to micelles composed of material of biological interest such as lecithin and cholesterol. In particular the role of cholesterol in making the micelle more rigid is discussed. This part of the work is extended to inner and outer membrane vesicles from Escherichia coli. The phase changes, clearly illustrated by this technique, show a distinct difference in the permeability of the inner and outer membranes. This difference may reflect compositional and structural differences between the inner and outer membrane. The effect of various additives such as basic anesthetics and ionic species on the degree and function of the permeability are also illustrated and discussed. (auth)

29537 REACTIONS OF NUCLEIC ACID RADICALS WITH RADIATION MODIFIERS. Greenstock, C. L.; Dunlop, I. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). pp 247-258 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

A review is presented of work carried out on the reactions of nucleic acid radicals with radiation modifiers (radiosensitizers and radioprotectors). Since evidence suggests that DNA is a principal radio-biological target within a cell, pulse radiolysis studies were undertaken, which showed that the purine and pyrimidine bases of DNA are extremely active towards hydrated electrons and hydroxyl radicals. The rate of electron transfer from nucleic acid radical anions to various electron-affinic compounds was found to be almost diffusion-controlled. The results and discussion are presented under the headings: electron transfer reactions, reactions of nucleic acid radicals with radiosensitizers, and reactions of nucleic acid radicals with radioprotectors. Conclusions are drawn about the chemical mechanism of electron-affinic sensitization. (UK)

29538 SENSITIZATION AND PROTECTION IN THE RADIATION CHEMISTRY OF BIOLOGICALLY ACTIVE DNA. van Hemmen, J. J.; Meuling, W. J. A. (National Defence Research Organization TNO, Rijswijk, Netherlands). pp 264-266 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

The results are reported of a study of the effects of the well-known sensitizers paranitroncetophenone (PNAP), triacetone-amine-N-oxyl (TAN) and oxygen, and of the protector cysteamine on the radiosensitivity of purified biologically active DNA of bacteriophages. Irradiation conditions are stated. The results are discussed. (UK)

29539 RADIATION INDUCED STRAND BREAKS AND TIME SCALE FOR REPAIR OF BROKEN STRANDS IN SUPERINFECTING PHAGE λ DNA IN ESCHERICHIA COLI LYSOGENIC FOR λ. Johansen, I.; Boye, E.; Brustad, T. (Univ. of Oslo). pp 267-274 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

The production of the first radiation induced break in covalent λ DNA molecules in pol$^+$ and pol A 1 lysogenic host cells was measured after exposure to electrons from a linear accelerator and transfer to alkaline detergent within 100 ms from the onset of irradiation. The results revealed the presence of an oxygen effect in DNA strand breakage. In both pol$^+$ and pol A 1 host cells the rate of production in nitrogen was 1.2×10^{-12} DNA single-strand breaks per rad per dalton as compared to 5×10^{-12} in oxygen. The yields of strand breaks in λ DNA in pol$^+$ host cells under oxygenated or anoxic conditions are independent of whether the cells are irradiated in buffer at room temperature, in buffer at ice temperature, or in growth medium at 37°C. These results indicate that enzymic repair of DNA strand breaks before analysis is insignificant in these experiments. The presence of an oxygen effect in DNA strand breakage under these conditions suggests that an actual difference exists between initial number of breaks produced in nitrogen and in oxygen. The kinetics of rejoining of broken molecules under optimal growth conditions was measured by incubating the irradiated host cells prior to lysis. In pol$^+$ host cells 50% of the λ DNA molecules broken in presence of oxygen are rejoined within 10 to 20 seconds of incubation. A significantly lower recovery is seen in pol$^+$ host cells after irradiation in nitrogen. The rejoining of broken λ DNA strands in pol A 1 host cells is impaired after irradiation in presence of oxygen as well as under anoxia. These results show that DNA polymerase I is needed for the rapid rejoining of radiation induced strand breaks in the DNA, and that oxygen promoted strand breaks are more easily rejoined than are those produced in nitrogen. (auth)

29540 ELECTRON TRANSFER PATHWAYS TO AND WITHIN REDOX PROTEINS: PULSE RADIOLYSIS STUDIES. Pecht, I.; Goldberg, M. (Weizmann Inst. of Science, Rehovoth, Israel). pp 277-284 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

The fine structural details of a number of electron mediating proteins (e.g., cytochromes, rubredoxin, ferredoxin) have been resolved recently by x ray crystallography, enabling a correlation between their structure and reactivity. Horse heart ferricytochrome c and Rhodospirillum rubrum ferricytochrome c_2 exhibit remarkable similarity in the mode of binding the haem and in its neighboring environment. A comparative pulse-radiolysis study of these two proteins has shown that both proteins react with the hydrated electron similarly. The direct bimolecular reduction by e^-_{aq} of the redox-active centres of several different electron mediating proteins has been observed. In addition to the above mentioned and several other cytochromes, non-haem iron proteins (ferredoxin and rubredoxin) and "blue" copper proteins (azurin and stellacyanin) were also investigated, and the results led to the same mechanistic conclusion. In contrast, the same type of redox centre, when part of a multi-site oxidase, such as the case of copper in ceruloplasmin or non-haem iron in xanthine oxidase, is reduced by a multi-step intramolecular electron transfer. The superoxide radical ion (O_2^-) has been found to act as an effective reductant of certain Cu(II) sites in copper containing oxidases. Molecular oxygen reoxidizes these centres fully at relatively fast rates. This finding opens up an interesting way to the investigation of the catalytic mechanism under conditions close to normal enzymatic turnover conditions. (auth)

29541 ELECTRON TRANSFER REACTIONS IN STRUCTURAL UNITS OF COPPER PROTEINS. Faraggi, M. (Nuclear Research Center, Beersheba, Israel). pp 285-308 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

In previous pulse radiolysis studies it was suggested that the reduction of the Cu(II) ions in copper proteins by the hydrated electron is a multi-step electron migration process. The technique has been extended to investigate the reduction of some structural units of these proteins. These studies include: the reaction of the hydrated electron with peptides, the reaction of the disulphide bridge with formate radical ion and radicals produced by the reduction of peptides, and the reaction of Cu(II)-peptide complex with e^-_{aq} and CO_2^-. Using these results the reduction mechanism of copper and other proteins will be discussed. (auth)

29542 FREE RADICAL REACTIONS WITH SUBTILISIN CARLSBERG. Bisby, R. H. (Univ. of Nottingham, Eng.); Cundall, R. B.; Adams, G. E.; Redpath, J. L. pp 309-318 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

Pulse radiolysis has been used to study the mechanisms of radiation-induced inactivation of enzymes. However, interpretation of the results is often complicated by the fact that the G values for enzyme inactivation are usually much smaller than the G values for the radicals formed from water radiolysis. Where inactivation by oxidative free radical attack is concerned, the problem can often be greatly simplified by the use of the free radical probe technique. These free radicals, which include the halide-type radicals Cl_2^-, Br_2^-, I_2^- and $(CNS)_2^-$, react much more selectively than OH radicals with amino acids. They can be used to demonstrate that selective oxidation of certain amino acid residues can lead to enzyme inactivation. The technique assists, therefore, in determining whether such sensitive amino acids are present in the active centre and are crucial to the activity of the protein. A number of enzymes have been studied by this method and the amino acid residues found to be necessary for enzymic activity are in agreement with those identified by conventional biochemical techniques. In these enzymes, free radical attack by the halide radicals leads to inactivation by damage to a single type of amino acid residue which is involved either in catalysis or binding of the substrate. Subtilisin Carlsberg is a serine protease consisting of a poly-peptide chain lacking both cysteine and cystine residues. This paper indicates the use of the selective probe technique in demonstrating that damage to one or more histidine residues leads to inactivation of the enzyme. (auth)

29543 SUPEROXIDE DISMUTASE INACTIVATION BY Br_2^- RADICALS. Roberts, P. B.; Fielden, E. M. (Inst. of Cancer Research, Sutton, Eng.). pp 319-326 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

Reference is made to the fact that if radiation is given at a high enough dose rate, the biological effect of oxygen is less than at low dose rates. Examples are given of "break-point" experiments showing the effect. It is stated that the rapid removal of a substance by radiation is not confined to oxygen: the only criterion required to demonstrate the effect is that the chemical causes a measurable sensitization or protection at a concentration small enough so that it can be depleted at a relatively low dose of radiation. Sufficient confidence is now placed in the effect that it can be used the other way round; that is, to measure the position of the break-point and from this measurement determine the oxygen concentration at the target site at the instant before irradiation. Examples are given of the use of the high dose rate technique for measuring the oxygen concentration inside mammalian cells (Chinese hamster cells). The effects of partial pressures of inert gases, and the effect of elevated gas pressures, are discussed. (UK)

29544 ANALYSIS OF MAMMALIAN TISSUE INTO LIPID AND LIPID-FREE FRACTIONS USING X AND GAMMA RADIATION. Preuss, L. E.; Bolin, E. P.; Bugenis, C. K. (Ford Inst. for Medical Research, Detroit, MI). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 549-550(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The fat and fat-free (muscle) constituents of soft tissue have mass absorption coefficients which are sufficiently separated in the 10–100 keV range as to allow the relative proportions of each of these components to be non-destructively determined by photon absorptiometry. The use of a dual photon beam eliminates variations due to sample density and thickness, thus making the method suitable for in vivo as well as in vitro work.

Radiation Effects on Cells

Refer also to abstracts 29582 and 29704.

29545 EFFECT OF SMALL DOSES OF IRRADIATION FROM RADON AND THE PRODUCTS OF ITS DECAY ON THE INCREASE IN BIOMASS AND THE LEVEL OF OXYGEN CONSUMPTION OF A PRIMARY CULTURE. Rekkandt, A. A.; Dobrachev, Yu. P. (Pyatigorsk Inst. of Treatment at Health Resorts and Physio-

therapy, USSR). Vopr. Kurortol., Fizioter. Lech. Fiz. Kul't.; 38: 243-246(1973). (In Russian)

The growth of the biomass of cells and oxygen consumption by tissues in media containing isotopes at concentrations from 3.6×10^{-5} to 3.6×10^{-2} μCi/ml and creating doses from 0.01 to 10 rad, is intensive; The magnitude of these values in stimulated cultures at specific times is 1½ to 2 times these values in non-irradiated cultures. Under the influence of radiation from radon and its decay products at doses of 0.005 to 10 rad the oxygen consumption of the tissue culture is intensified which characterizes a very high level of exchange in the stimulated culture. Increase of the oxygen consumption correlates with the growth of the biomass which indirectly indicates the normal growth of stimulated cell cultures. The most intense oxygen consumption from the medium and the growth of the biomass day of growth was observed at doses of 0.1 to 0.3 rad. Under the influence of low doses of α radiation the adaptation phase was shortened and the rate of growth of the tissues and the level of metabolism of the culture cells was increased. (tr-auth)

29546 EFFECT OF HYPOXIA AND DOSE RATE ON THE SHAPE OF SURVIVAL CURVES FOR EMT6 TUMOR AND B14FAF CELL IN VITRO. Phillips, T. L.; Fu, K. K.; Kane, L. J. (Univ. of California, San Francisco). pp 158-166 of Proceedings of the 6th L. H. Gray Conference. Bristol, Eng.; Institute of Physics (1975).

B14FAF Chinese hamster cells and EMT6 mouse mammary tumor cells grown in vivo and irradiated and assayed in vitro were used to measure the effects of hypoxia and dose rate on the shape of cell survival curves. In the studies of B14FAF cells bubbled with gases and irradiated at 100 rad min^{-1}, the extrapolation number (n) was 11 in air and 1.6 in nitrogen. When sealed ampoules were used to create hypoxia and the cells irradiated at 275 rad min^{-1}, n was 6.6 for air and 17 for hypoxia. The initial slopes of the log survival curves yielded values of D_0 of 490 rad in air and 2120 rad under hypoxic conditions. The terminal D_0 values were 173 and 400 rad, respectively. When the dose rate was dropped to 4.5 rad min^{-1}, no significant changes in D_0 were noted. For EMT6 cells, values of n of 13.5 in air and 9.8 under hypoxic conditions and terminal values of D_0 of 139 and 356 rad, respectively, were obtained at 275 rad min^{-1}. At 4.5 rad min^{-1} there was a significant change in the aerated D_0 to 438 rad and no significant change in the hypoxic D_0. In both cases at the low dose rate n dropped to 1.2-1.3. The results indicate that the method of producing hypoxia, the cell type, and the dose rate determine the D_0 and n values that will be obtained. (auth)

29547 HUMAN DISEASES WITH GENETICALLY ALTERED DNA REPAIR PROCESSES. Cleaver, J. E. (Univ. of California, San Francisco); Bootsma, D.; Friedberg, E. Genetics; 79: 215-225(Jun 1975).

DNA repair of single-strand breaks (produced by ionizing radiation) and of base damage (produced by ultraviolet (UV) light) are two repair mechanisms that most mammalian cells possess. Genetic defects in these repair mechanisms are exemplified by cells from the human premature-aging disease, progeria, which fail to rejoin single-strand breaks, and the skin disease, xeroderma pigmentosum (XP), which exhibits high actinic carcinogenesis and involves failure to repair base damage. In terms of the response of XP cells, many chemical carcinogens can be classified as either X-ray-like (i.e., they cause damage that XP cells can repair) or UV-like (i.e., they cause damage that XP cells cannot repair). The first group contains some of the more strongly carcinogenic chemicals (e.g., alkylating agents). XP occurs in at least two clinical forms, and somatic cell hybridization indicates at least three complementation groups. In order to identify cell lines from various different laboratories unambiguously, a modified nomenclature of XP lines is proposed. (auth)

29548 FORMATION AND REPAIR OF THYMINE DAMAGE IN DNA OF MAMMALIAN CELLS EXPOSED TO GAMMA RADIATION. Mattern, M. R. Princeton, NJ; Princeton Univ. (1975). 127p. University Microfilms Order No. 76-257.

Thesis (Ph. D.).

Chinese hamster ovary (CHO) cells growing exponentially in tissue culture were exposed to gamma rays and subsequently incubated at 37°C for various periods of time. The TCA-soluble intracellular and extracellular material was analyzed for both damaged and undamaged thymine residues. It was found that a major class of thymine radiation product—ring-saturation derivatives of the 6-hydroxy(hydroperoxy)-5,6-dihydrothymine type—appears in cellular acid-soluble material and in the postirradiation incubation medium within minutes after irradiation. A radiation-specific release of unaltered thymine residues occurs concomitantly, indicating the operation of a controlled process of DNA degradation. Three actively-growing mammalian cell lines—two of human and one of rodent origin—were irradiated with high doses of gamma rays and their DNA analyzed, following various periods of postirradiation incubation, for the presence of 5,6-dihydroxydihydrothymine-type radiation products. Diploid human fibroblasts (WI-38) exhibited a rapid and selective excision of damaged thymines from the DNA. A similar process occurred in both virally-transformed human fibroblasts (VA13) and in cells of the permanent CHO line. Corresponding appearance of thymine radiation products was detected in acid-soluble material during post-irradiation incubation. (Diss. Abstr. Int., B)

29549 DNA STRAND BREAKS, REPAIR, AND SURVIVAL IN X-IRRADIATED MAMMALIAN CELLS. Dugle, D. L.; Gillespie, C. J.; Chapman, J. D. (Atomic Energy of Canada, Ltd., Manitoba). Proc. Natl. Acad. Sci. U. S. A.; 73: No. 3, 809-812(Mar 1976).

The yields of unrepairable single- and double-strand breaks in the DNA of x-irradiated Chinese hamster cells were measured by low-speed neutral and alkaline sucrose density gradient sedimentation in order to investigate the relation between these lesions and reproductive death. After maximal single-strand rejoining, at all doses, the number of residual single-strand breaks was twice the number of residual double-strand breaks. Both double-strand and unrepairable single-strand breaks were proportional to the square of absorbed dose, in the range 10-50 krad. No rejoining of double-strand breaks was observed. These observations suggest that, in mammalian cells, most double-strand breaks are not repairable, while all single-strand breaks are repaired except those that are sufficiently close on complementary strands to constitute double-strand breaks. Comparison with cell survival measurements at much lower doses suggests that loss of reproductive capacity corresponds to induction of approximately one double-strand break.

29550 CYTOLOGICAL EVIDENCE FOR SWITCHES IN POLARITY OF CHROMOSOMAL DNA. Wolff, S.; Lindsley, D. L.; Peacock, W. J. (Univ. of California, San Francisco). Proc. Natl. Acad. Sci. U. S. A.; 73: No. 3, 877-881(Mar 1976).

From the types of ring chromosomes induced in x-irradiated Chinese hamster ovary (CHO) cells, we deduce the existence of switches in the polarity of chromosomal DNA; if there is a continuous DNA double helix along the full length of the chromosome then the polarity switches imply 3'-3' and 5'-5' phosphodiester linkages. The resolution of the method is such that we estimate that there is one polarity switch for every 10^9 normal 3'-5' phosphodiester bonds.

29551 EFFECT OF N-ETHYLMALEIMIDE ON THE RESPONSE TO X RAYS OF SYNCHRONIZED HeLa CELLS. Han, A.; Sinclair, W. K.; Kimler, B. F. (Argonne National Lab., IL). Radiat. Res.; 65: No. 2, 337-350(Feb 1976).

The presence of 0.75 mu M N-ethylmaleimide (NEM) during irradiation of synchronous HeLa cells at different stages of their cycle enhances cell killing (i.e., sensitizes) in early G_1 and late S, but does not affect mitotic cells or cells at the G_1/S border. The effect is primarily on the shoulder of the survival curve, rather than its slope. NEM given immediately before or after irradiation is as effective as during irradiation. When given as a function of time after exposure the effect decreases in magnitude, cells becoming insensitive to NEM more rapidly in S than in G_1. The drug is also effective if administered prior to irradiation, the effect generally decreasing the longer the interval between treatment and irradiation. The addition of 1.0 mM hydroxyurea (HU) to synchronous HeLa cells in G_1 showed that survival changes occur as the cells proceed through the cell cycle even in the absence of DNA synthesis. The changes observed are qualitatively the same as those observed previously in Chinese hamster cells. The irradiation of HU-inhibited cells in the presence of 0.75 mu M NEM produced almost no variation in survival through the cycle, the inhibited cells showing a sensitivity greater than that normally observed in mitotic cells. The results presented are consistent with the idea that NEM inhibits repair processes in the cell most likely due to its binding to a critical SH-containing enzyme(s) concerned with the repair of radiation damage. (auth)

29552 QUANTITATIVE ANALYSIS OF THE INFLUENCE OF DOSE FRACTIONATION ON THE RELATIVE CYTOGENETIC EFFECTIVITY OF HIGH-ENERGY ELECTRONS. Pertsov, L. L.; Kozlov, A. P.; Akimov, A. A.; Moskalik, K. G. (Scientific-Research Inst. for Oncology, Leningrad). Radiobiol. Radiother.; 16: No. 6, 663-670(1975). (In German)

In the present paper the influence of a fractionated irradiation on chromosome alteration in Ehrlich tumour cells under the effect of 200-kv x-radiation and 20-mev electron radiation is studied and mathematically represented. A single irradiation with high-energy electron radiation and x-radiation, respectively, with a dose of 100 rd led to the formation of a higher number of cells with chromosome alteration and an increased alteration rate per cell than with a fractionated irradiation with

the same total dose. An intensified decrease in the number of cells with chromosome alteration and in the alteration rate per cell occurred under fractionated irradiation with high-energy elektrons. The reduction of the relative biological effectivity of high-energy electrons under fractionated irradiation can be represented by means of a "target-theory" apparatus. (auth)

29553 USE OF HYPOXIC CELL RADIOSENSITIZERS TO IDENTIFY HYPOXIA IN MOUSE BONE MARROW IN VIVO. Keizer, H. J.; Pijpers-de Bruin, M. M.; van Putten, L. M. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 22-24 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29554 INCREASED RADIOSENSITIVITY INDUCED BY PROTRACTED IRRADIATION. Kal, H. B. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 15-17 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29555 REPAIR OF RADIATION DAMAGE TO CAPILLARY ENDOTHELIUM. Reinhold, H. S.; Buisman, G. H. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 18-19 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29556 FAST REMOVAL OF OXYGEN FROM BIOLOGICAL SYSTEMS. Dewey, D. L.; Michael, B. D. (Mt. Vernon Hospital, Northwood, Eng.). pp 364-371 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

A report is presented on steady-state inactivation and pulse radiolysis studies of superoxide dismutase, a copper-containing enzyme of unknown structure, when exposed to Br_2^- radicals. Two forms of superoxide dismutase from erythrocytes were used, designated bovine and human enzyme. Steady-state irradiations were carried out on N_2O-saturated solutions of enzyme containing KBr or t-butanol in phosphate or pyrophosphate buffer at the required pH. The irradiated samples were assayed by the pulse radiolysis method. Measurements of the rate of the Br_2^--enzyme reaction and the resultant product spectrum were carried out by the standard pulse radiolysis technique. The results are discussed. (UK)

29557 GROWTH AND VIABILITY OF AEDES ALBOPICTUS CELL LINE IN VITRO AFTER CESIUM-137 GAMMA IRRADIATION. Blakely, E. A. Urbana, IL; Univ. of Illinois (1975). 152p. University Microfilms Order No. 75-24,764.

Thesis (Ph. D.).

The radiosensitivity of the cultured mosquito cell line Aedes albopictus (Skuse) was investigated. Population growth was followed by total cell counts and by viable cell counts on aliquots of cultures exposed to various doses of gamma radiation during exponential growth. Viable cell determinations were based on the cellular exclusion of the dye, alcian blue, in a procedure adapted to the insect cells in culture. Viability determinations in the irradiated exponential cultures indicated that initially there was some increase in the gestation, suggesting that gonadal steroids may have unusual effects on uterine physiology and biochemistry in this species. Consequently, studies were undertaken to elucidate some of the basic responses of hamster uteri to estradiol benzoate and progesterone under conditions of protein malnutrition, actinomycin D administration and corticosterone injection. Furthermore, the effects of gonadal steroids on uteri of pregnant ovariectomized hamsters were studied. (Diss. Abstr. Int., B)

Radiation Effects on Microorganisms

Refer also to abstracts 29515, 29521, 29522, 29530, and 30294.

29558 (IAEA-R-972F) PRESERVATION OF TROPICAL FRUITS BY IRRADIATION; PAPAYAS, MANGOS, PINEAPPLES AND BANANAS. Part of a Coordinated Programme on the Shelf-life Extension of Irradiated Fruits and Vegetables. Final Report for the Period 15 March 1970-31 August 1974. Cabrera Mosqueda, L. (International Atomic Energy Agency, Vienna (Austria)). Oct 1974. 18p. (In Spanish). INIS.

Effects of irradiation treatment on fruits of commercial importance in Mexico such as mangoes, strawberries, tomatoes, bananas, papaya, pineapples, oranges and peaches were investigated. The fruits were irradiated at various doses and later stored at either ambient conditions, 16-26°C and 45-60% relative humidity, or at 20 ± 1°C and 50 ± 5% relative humidity. Irradiation of mangoes with 100 krad resulted in the prolongation of market life by 12 days. No significant change was found in the chemical constituents of irradiated fruit. Irradiation of strawberries with 360 krad and above resulted in at least 2-times reduction in spoilage index. The rate of ripening of tomatoes could be delayed and, thereby, the market life extended by 8 days when the fruit was treated with 400 krad. Slight inhibition of ripening of bananas during prolonged storage was observed when irradiated at 5 krad. Irradiation of papaya with doses up to 80 krad caused no significant change in chemical constitutents. General appearance of pineapples during storage was improved by irradiation at doses between 30 and 60 krad. The maximum tolerable dose for mature green tangerine oranges was found to be 5 krad and for the fully ripe ones at 100 krad. Significant decrease in ascorbic acid content was observed in peaches irradiated at 250 krad and above. (INIS)

29559 (IAEA-R-1060-F) GAMMA IRRADIATION FOR DISINFESTATION OF SALTED AND DRIED FISH. Final Report for the Period 1 November 1971-31 October 1974. Loaharanu, S. (International Atomic Energy Agency, Vienna (Austria)). Jan 1975. vp. INIS.

About 60-70% of commercially salted and dried fish were found to be infested by flies of 6 different species, i.e., the Cheese skipper (Piophila casei, L.) the Bronze bottle fly (Paenicia cuprina), the Screw worm fly (Chrysomya megacephala, Fab.), the Red-tailed flesh fly (Sarcophaga haemorrhoidalis, Fallen), Lucilia illustris, Meigen and Chrysomya marginalis, Weidemann. Larvae of the Cheese skipper were found to be the least radiation-sensitive, as 225 krad was required to prevent 99% of the larvae from developing into pupae. This dose was completely lethal to other developmental stages of the Cheese skipper and to all stages of other species. No significant difference was observed on the organoleptic properties between salted and dried mackerel and Pla salid (Trichogaster pectoralis, Regan), a fresh water fish, irradiated up to 300 krad and those of untreated samples when tested up to 6 months of storage time at room temperature. Polypropylene bags of 0.13 and 0.20 mm thickness and polyethylene bags of 0.20 mm thickness could prevent re-infestation of the samples. Transportation tests by truck for a distance of 800 km revealed that both polypropylene and polyethylene bags of 0.13 and 0.20 mm thickness were suitable to package the mackerel samples but only polypropylene bags of 0.20 mm thickness were sufficient to protect the Pla salid samples. It appeared that salted and dried mackerel irradiated up to 300 krad and stored for 4 months was not considered rancid. No change in fat, protein and ash contents of irradiated samples was observed. It was concluded that γ irradiation could be considered as an effective method for disinfesting and preserving salted and dried fish.

29560 (IAEA-R-1479-F) EVALUATION OF ECONOMIC FEASIBILITY OF IRRADIATED FOOD ITEMS ACCEPTED FOR HUMAN CONSUMPTION. Final Report for the Period 15 March 1974-30 November 1974. Balasz-Sprincz, V. (International Atomic Energy Agency, Vienna (Austria)). Dec 1974. 75p. INIS.

Evaluations of the economic feasibility of food irradiation from existing literature were carried out in the following categories: cost estimates for sprout inhibition of potatoes and onions; dose requirement about 10 krad. Cost estimates for disinfestation of grain; dose requirement about 30 krad. Cost estimates for growth retardation of mushrooms; dose requirement 100 krad. Cost estimates of radiation pasteurization of meat and fish; dose requirement about 200 krad. It was found that the throughput of a facility in terms of tons of food item per year would be the most suitable parameter for a comparative analysis. Cost estimates on the above categories were made according to the plant size, viz. small, medium and large. Investigation of total capital investment, annual running cost and unit cost of treatment of each plant was carried out. The comparison of the costs between irradiation and chemical treatment in terms of sprout inhibition and insect disinfestation showed the two costs to be of about the same order of magnitude. Both irradiation and chemical treatments appeared to be equally feasible for the preservation of produce. The two methods should be considered complementary instead of substituting. In practical realization probably other aspects such as technical feasibility, safety, health, etc. will be considered first, economy only afterwards. (INIS)

29561 (ZAED-BIBL.-05-16) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. Section 05: Irradiation of Foods. Number 16. Ehlermann, D.; Gruenwalk, T.; Harmuth-Hoene, A. E.; Muenzner, R.; Delincee, H. (comps.). (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Nov 1975. 39p. (In several languages). Dep. NTIS (US Sales Only) $4.00.

References, with indexes, are presented to the world literature during 1973 and 1974 on food irradiation. (CH)

29562 EFFECTS OF γ RADIATION ON THE CHEMICAL CONSTITUENTS OF SOME SOUTH AFRICAN VARIETIES OF

POTATOES. Winchester, R. V.; Visser, F. M. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Chemistry Div.). Atomkernenergie; 26: No. 4, 276-278(1975).

2 figs.; 13 refs.

Effects of γ radiation on the ascorbic acid, reducing sugar, sucrose, and starch contents of five varieties of potatoes grown in South Africa have been studied. Doses of up to 15 krad cause no detrimental effects on the ascorbic acid, sucrose, and starch contents up to sixteen weeks after irradiation. Reducing sugars in two varieties, both irradiated and unirradiated, accumulate after ten weeks and may make these varieties unsuitable for commercial processing after any longer storage. The sugar accumulation is probably caused by unsuitable storage conditions rather than by irradiation and might be reversible by controlled temperature storage or by reconditioning. (DE)

29563 MODEL ON THE INDUCTION BY UV IRRADIATION OF ESCHERICHIA COLI BACTERIA LYSOGENIC WITH THE BACTERIOPHAGE λ. Noack, D.; Ronto, G. (Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie, Jena, Ger.). Z. Allg. Mikrobiol.; 14: No. 1, 63-67(1974). (In German)

The induction of λ prophages in lysogenic Escherichia coli cells is started after inactivation of repressor molecules coded for by the prophage genome itself. All agents known to inhibit bacterial DNA synthesis are able to initiate a set of processes resulting in the inactivation of these repressors. In the case of uv light as an inducing agent it is suggested that the uv mediated damages within the bacterial DNA diminish the replication velocity leading through a set of intermediate processes to the inactivation of phage repressors by accumulation of repressor inactivating precursors of DNA synthesis. The analytical function for the dose effect curve is obtained from the product of the probability P_l of cells containing l uv damages multiplied by the number l of uv damages after summing up all possible numbers of l. The probability of P_l is calculated on the basis of the radiation kinetic model of Rontó et al. (1972). The theoretical dose effect curve obtained shows a shoulder with an extrapolation number of 1.2 and a linear part at high irradiation doses in semilogarithmic plot. The experimental data obtained with uv induction of E. coli K12 (λ) are consistent with the model and show that only a few uv damages smaller than 10 per bacterial chromosome are sufficient for induction. (auth)

29564 EXPERIMENTAL ANALYSIS OF A RABIES VACCINE FROM SHEEP BRAIN TISSUE INACTIVATED BY ULTRAVIOLET RAYS. Pospeeva, N. A.; Morogova, V. M.; Gil'dina, S. S.; Nikolayeva, N. V.; Losev, M. N. (Scientific Research Inst. of Vaccines and Serums, Moscow). Vopr. Virusol.; No. 5, 578-581 (1975). (In Russian)

Twenty percent rabies vaccine in physiological solution from sheep brain, to which an equal volume of 15% sucrose solution was added, and which was subjected to ultraviolet radiation at a distance of 20 cm at a rate of 3.3-3.6 liters/hour, demonstrated a statistically significant difference in immunogenic activity from commercial Fermi vaccine. Replacement of Fermi vaccine is recommended because the new vaccine is less dangerous in regard to postvaccination complications. (JPRS)

29565 SPECIFIC MACROPHAGE IMMUNITY TO SENDAI VIRUS: MACROPHAGE AGGREGATION IN VITRO WITH SENDAI VIRUS BY CYTOPHILIC ANTIBODIES. Watanabe, M.; Tozawa, H.; Kumagai, K.; Ishida, N. (Tohoku Univ., Sendai). Infect. Immun.; 12: No. 2, 324-332(Aug 1975).

When a 24-h tube culture of rabbit alveolar macrophages was infected with Sendai virus, the rate of infected cells was found to be limited. Even at a multiplicity of infection (MOI) of 500 plaque-forming units per cell, an average of 63 percent cells was found to synthesize viral antigens stainable by direct immunofluorescence. When the macrophages obtained from rabbits hyperimmunized by an intravenous injection of Sendai virus were infected under the same in vitro conditions, the rate of antigen synthesis averaged as low as 23 percent. At the time of infection of alveolar macrophages from immunized rabbits (immune macrophages), cell aggregation at an MOI 50 and cell fusion at an MOI 500 were found 24 h after infection, and these reactions were never encountered after the infection of nonimmune macrophages. When the immune macrophages were either pretreated by trypsin or incubated in medium at pH 4.0, the infection no longer caused the aggregation. The supernatant fluid obtained after incubation at pH 4.0 contained neutralizing antibody to Sendai virus. Conversely, when nonimmune macrophages were incubated in the presence of rabbit anti-Sendai virus serum or purified immunoglobulin G, the same aggregation reaction occurred after virus infection. Ultraviolet light-killed Sendai virus could be used as the counterpart of alive virus in the same aggregation reaction. These results suggest that the aggregation reaction of the immune macrophages could be attributed to the presence of specific cytophilic antibodies on their surface. (auth)

29566 CHANGES IN BUOYANT DENSITY RELATIONSHIPS OF TWO CELL TYPES OF COXIELLA BURNETI PHASE I. Wachter, R. F.; Briggs, G. P.; Gangemi, J. D.; Pedersen, C. E. Jr. (Army Medical Research Inst. of Infectious Diseases, Frederick, MD). Infect. Immun.; 12: No. 2, 433-436(Aug 1975).

Coxiella burneti phase I, purified from a formalin-inactivated yolk-sac vaccine, was separated into two bands of morphologically distinct cell types when subjected to sucrose gradient centrifugation. Recycling of the less dense, rod-shaped cells in unbuffered sucrose gradients (pH 5.5 to 6.0) resulted in the formation of bands having the location and appearance of the original two bands. Recycling of the denser band of larger ovoid-shaped cells yielded a single band, suggesting that the larger cell type arose from the smaller cell. In contrast to vaccine-derived rickettsiae, live, cell culture-propagated phase I organisms formed a single band in unbuffered sucrose gradients, at the same density as the upper band of the vaccine preparation. Centrifugation of cell culture-derived rickettsiae for 26 to 48 h in sucrose gradients of pH 5.5 resulted in the formation of a second band, at the same density as the lower band of the vaccine preparation. This did not occur in gradients of pH 7.0. Treatment of cell culture-propagated rickettsiae with formalin or germicidal ultraviolet radiation induced a total shift of the less dense cell population to a zone of higher density when centrifuged isopycnically in CsCl gradients. This density change did not occur in sucrose gradients, suggesting a difference in the effect of these treatments on the permeability of the cell membrane to sucrose and CsCl. (auth)

29567 VISCOSITIES OF ACACIA AND SODIUM ALGINATE AFTER STERILIZATION BY COBALT-60. Hartman, A. W.; Nesbitt, R. U. Jr.; Smith, F. M.; Nuessle, N. O. (Univ. of Missouri, Kansas City). J. Pharm. Sci.; 64: No. 5, 802-805(May 1975).

Acacia and sodium alginate powders were sterilized by cobalt-60 irradiation to a total dose of 2.5 Mrad with no increase in residual radioactivity of the gums as a result of the treatment. Viscosity measurements showed an 11 percent reduction in the viscosity of acacia in water and a 16 percent decrease in the intrinsic viscosity in barium chloride solution due to the irradiation. Viscosities of sodium alginate solutions in 0.1 N sodium chloride showed a 70 percent decrease in intrinsic viscosity, indicating changes in the molecular structure corresponding to degradation to 30 percent of the original degree of polymerization. This dose of gamma-radiation from cobalt-60 is not an appropriate method of sterilization for these gums. (auth)

29568 UV SENSITIVITY OF A NONREPRESSOR REGULATORY PROTEIN OF BACTERIOPHAGE P22. Tokuno, S. I.; Gough, M. (State Univ. of New York, Stony Brook). J. Virol.; 18: No. 1, 65-70(Apr 1976).

The product of phage P22 gene c1 has two functions: it promotes synthesis of P22 repressor and it retards expression of some lytic genes. We present evidence that this product is inactivated in UV-irradiated hosts. The conditions for inactivation of c1 product include a functional DNA recombination system involving the host recA gene. (auth)

29569 GAMMA-INDUCED MUTANTS OF STREPTOCOCCUS LACTIS WITH AN INCREASED NISIN PRODUCTION. Hylmar, B.; Teply, M. (Vyzkumny Ustav Mlekarensky, Prague (Czechoslovakia)); Pokorna, L. (Vyvojovy Zavod Mlekarenskeho Prumyslu, Prague (Czechoslovakia)). Prum. Potravin; 26: No. 2, 86-89(27 Feb 1975). (In Czech).

Mlekarske List. Supplement to Prum. Potravin (1975), v. 1(1) p. 1-9.

Gamma irradiation was applied in obtaining mutants of Streptococcus lactis showing an increased nisin production. While the original strain produced 470 m.u. of nisin in stationary cultivation, the most productive radiation-induced mutants produced 1,700 m.u. of nisin in 1 liter of milk. The mutants were found to be sufficiently stable as for their production properties. Submersion cultivation of the mutants even increased nisin production, both in milk and in the production whey medium containing $CaCO_3$. (INIS)

29570 EFFECTS OF SOLAR ULTRAVIOLET RADIATIONS ON BACILLUS SUBTILIS SPORES AND T-7 BACTERIOPHAGE. Spizizen, J. (Scripps Clinic and Research Foundation, La Jolla, CA); Isherwood, J. E.; Taylor, G. R. pp 143-149 of Life Sciences and Space Research. XIII. Berlin; Akademie-Verlag GmbH (1975).

From proceedings of the seventeenth plenary meeting; Sao Paulo, Brazil (17 Jun 1974).

Spores of Bacillus subtilis HA 101 and the DNA polymerase I-defective mutant HA 101 (59)F were exposed to selected wavelengths of solar ultraviolet light and space vacuum during the return of Apollo 16. In addition, coliphage T-7 suspensions were exposed to solar ultraviolet radiation as part of the Microbial

Response to Space Environment Experiment. Optical filters were employed to provide different energy levels at wavelengths 254 nm and 280 nm. Dose-response curves for lethal and mutagenic effects were compared with ground-based data. A close parallel was observed between the results of solar radiation and ground tests with spores of the two strains. However, significantly greater inactivation of T-7 bacteriophage was observed after exposure to solar ultraviolet radiation. (auth)

29571 EFFECT OF IONIZING RADIATIONS WITH DIFFERENT LET ON SURVIVAL AND MUTATION IN CHLORELLA. Dubinin, N. P.; Shevchenko, V. A.; Rubanovich, A. V.; Vekshina, L. K.; Sakovich, I. S. pp 181-186 of Life Sciences and Space Research. XIII. Berlin; Akademie-Verlag GmbH (1975).

From proceedings of the seventeenth plenary meeting; Sao Paulo, Brazil (17 Jun 1974).

Experiments were conducted on the relative biological efficiency (RBE) of ionizing radiations with varying linear energy transfer (LET). Survival curves were sigmoid for low-LET radiations (such as gamma rays), but they were exponential in the case of high-LET radiations (e.g., multiply-charged ions of carbon, boron, and neon). Mutation rate was linear with dose for gamma rays, but it reached a maximum at certain prescribed doses for charged-particle irradiation. The highest RBE occurred with multiply-charged carbon ions. (STAR)

29572 PECULIARITIES OF BIOLOGICAL ACTION OF HADRONS OF SPACE RADIATION. Akoev, I. G.; Iurov, S. S. (Inst. of Biofiziki, Pushchino-on-Oka, USSR). pp 187-193 of Life Sciences and Space Research. XIII. Berlin; Akademie-Verlag GmbH (1975).

From proceedings on the seventeenth plenary meeting; Sao Paulo, Brazil (17 Jun 1974).

A review of experimental data on the somatic and genetic effects of high-energy hadrons is presented, based on data obtained in space and from high-energy accelerator studies; the physical and molecular principles behind these effects are discussed. Data concern relative biological efficiency (RBE) and linear energy transfer (LET). In particular, the results of 70 GeV proton radiation on bacteriophage T4B and Vicia faba were studied. It is concluded that the molecular mechanism of mutagenesis under the action of high-energy hadrons is due to multiple DNA changes caused by burning a narrow cone of secondary particles and producing deletions of various dimensions. Moreover, secondary radiation generated by high-energy hadrons upon their interaction with spaceships is likely to be the greatest hazard of radiation during space flights. (STAR)

29573 RESULTS OF THE BACILLUS SUBTILIS UNIT OF THE BIOSTACK II EXPERIMENT. Physical Characteristics and Biological Effects of Individual Cosmic HZE Particles. Buecker, H.; Facius, R.; Hildebrand, D.; Horneck, G. (Univ., Frankfurt am Main). pp 161-166 of Life Sciences and Space Research. XIII. Berlin; Akademie-Verlag GmbH (1975).

From proceedings of the seventeenth plenary meeting; Sao Paulo, Brazil (17 Jun 1974).

The effectiveness of cosmic HZE-particles on unicellular procaryotic organisms was studied on Bacillus subtilis spores, which were accommodated in the Biostack I and II experiments on board Apollo 16 and 17. Identification of the spores that were hit was achieved by using the Biostack sandwich construction and by precise microscopical measurements of tracks of particles. Germination, outgrowth and the rate of cellular elongation were investigated. A method was developed to determine the charge of each individual HZE particle that penetrated a spore and its energy loss in the region of hit. An attempt was made to establish a connection between these physical characteristics and the biological effects produced. (auth)

29574 PHYSICAL DOSIMETRIC EVALUATIONS IN THE APOLLO 16 MICROBIAL RESPONSE EXPERIMENT. Taylor, G. R. (Johnson Space Center, Houston, TX); Bailey, J. V.; Benton, E. V. pp 135-141 of Life Sciences and Space Research. XIII. Berlin; Akademie-Verlag GmbH (1975).

From proceedings of the seventeenth plenary meeting; Sao Paulo, Brazil (17 Jun 1974).

Texts of high-energy multicharged particle, ultraviolet light, and galactic irradiation fluxes on exposed biological specimens aboard Apollo 16 are described. Passive nuclear track detectors, passive dosimeters, and thermoluminescent dosimeters, respectively, were used for the measurements. Biological phenomena studied ranged from lipolytic alpha toxin production in Bacillus thuringiensis to animal tissue invasion (of human hair by Trichophyton terrestre). Fluxes observed were lower than those recorded by detectors located in the Biostack and in the passive personnel dosimeters worn by the astronauts, suggesting a greater average shielding in the latter two environments. (STAR)

29575 AN EVALUATION OF THE APPLICABILITY OF GAMMA RADIATION FOR PREPARING TYPHOID FEVER VACCINE. Malafiej, E.; Lachmanowa, S.; Horoszewicz-Malafiej, A. (Wojskowa Akademia Medyczna, Lodz (Poland); Politechnika Lodzka (Poland). Instytut Techniki Radiacynej). Med. Dosw. Mikrobiol.; 26: 93-98(1974). (In Polish).

For English translation see the journal Exp. Med. Microbiol.

Using mouse protection test, two typhoid fever vaccines were comparatively tested for efficacy: that prepared by thermal inactivation and that treated with ionizing radiation. The experiments were performed with white mice BALB/c. ^{60}Co was used as the radiation source. Vaccine prepared by thermal inactivation showed higher protective activity than the vaccine prepared by treatment with ionizing radiation. (auth)

29576 INACTIVATION OF BACTERIOPHAGES IN NUTRIENT BROTH AND IN THE PRESENCE OF CYSTEINE BY RADIATION OF DIFFERENT LET'S AND ATTEMPTS FOR THE THEORETICAL INTERPRETATION OF RESULTS. Erzgraeber, G.; Tolkendorf, E.; Abel, H. (Central Inst. of Molecular Biology, Berlin). Stud. Biophys.; 52: No. 3, 185-195(1975).

T1 and T2 bacteriophages were irradiated with x-rays, deuterons α-particles and with the heavy ions ^{12}C and ^{22}Ne in broth and in broth with cystein ($2.5\ keV/\mu m < L_\infty < 890\ keV/\mu m$). The interpretation of the results follows by means of the theory of two types of damages (single-strand and double-strand damages) of MUNSON et al. The conclusions are the following: in broth 10% of the produced single-strand damages are lethal. In broth with cystein only 0.5% of the produced single-strand damages for T2 phages and 3% for T1 phages are the inactivating effects. From our own results and the published data it may be said that the T-even possess an own repair system, which is more effective than the host cell repair for uneven T phages. The experimental factors of protection are given and discussed. (auth)

29577 EFFECT OF AN ELECTROMAGNETIC MICROWAVE RADIATION ON THE GROWTH OF BACTERIA. Berteaud, A. J.; Dardalhon, M.; Rebeyrotte, N.; Averbeck, D. (Centre National de la Recherche Scientifique, 94-Thiais (France). Laboratoires de Vitry-Thiais; Institut du Radium, 75-Paris (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 281: No. 12, 843-846(22 Sep 1975). (In French)

The study on the growth of E. coli cells under low power microwave irradiation the frequency of which can vary between 70 and 75 GHz, demonstrates that in neighbourhood of 70.5 and 73 GHz a slowdown of growth is most frequently observed. On the contrary, the survival is not altered as long as the power of the irradiation is low. The irradiation does not induce lesions in DNA, whatever the frequency may be. (FR)

29578 EFFECTS OF PUROMYCIN AMINONUCLEOSIDE AND PUROMYCIN ON ULTRAVIOLET IRRADIATED ESCHERICHIA COLI STRAINS. Sideropoulos, A. S.; Greenberg, J. (Medical Coll. of Pennsylvania, Philadelphia). Mutat. Res.; 29: No. 1, 139-143(Jul 1975).

29579 DISTRIBUTION OF MUTATIONS INDUCED BY ETHYL METHANESULFONATE AND ULTRAVIOLET RADIATION IN ESCHERICHIA COLI CHROMOSOME. Guerola, N.; Cerda-Olmedo, E. (Univ., Sevilla, Spain). Mutat. Res.; 29: No. 1, 145-147(Jul 1975).

29580 FURTHER EVIDENCE FOR AN INDUCIBLE RECOMBINATION REPAIR SYSTEM IN USTILAGO MAYDIS. Holliday, R. (National Inst. for Medical Research, London). Mutat. Res.; 29: No. 1, 149-153(Jul 1975).

29581 TRANSIENT CHEMICAL SPECIES IMPORTANT IN SOME OF THE RADIATION EFFECTS IN SPORES. Powers, E. L. (Univ. of Texas, Austin). pp 329-340 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

Reference is made to experiments on compounds that affect the radiation sensitivity of the bacterial spore. It has been established that ·OH can be important in the anoxic sensitization of spores by N_2O in aqueous suspension. Pertinent reactions of e^-_{aq} and ·OH are discussed. The evidence for a role for H_2O_2 in anoxic sensitization and, in one instance, oxic sensitization, is stated, and a summary is given of the actions of a number of metals and metal complexes. Conclusions are drawn about the mechanisms for the various reactions. (UK)

29582 OXYGEN DIFFUSION KINETICS AND REACTIVE LIFETIMES IN BACTERIAL AND MAMMALIAN CELLS IRRADIATED WITH NANOSECOND PULSES OF HIGH INTENSITY

ELECTRONS. Epp, E. R.; Weiss, H.; Ling, C. C.; Djordjevic, B.; Kessaris, N. D. (Sloan-Kettering Inst. for Cancer Research, New York). pp 341-363 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

Experiments have been designed to gain information on the lifetime of oxygen-sensitive species suspected to be produced in critical molecules in irradiated cells and on the time-diffusion of oxygen in cells. An approach developed in this laboratory involves the delivery of two high intensity electron pulses each of 3 ns duration to a thin layer of cells equilibrated with a known concentration of oxygen. The first pulse serves to render the cells totally anoxic by the radiochemical depletion of oxygen; the second is delivered at a time electronically delayed after the first allowing for diffusion of oxygen during this time. Under these conditions the radiosensitivity of E coli B/r has been measured over six decades of interpulse time. Cellular time-diffusion curves constructed from the measurements show that oxygen establishes its sensitizing effect within 10^{-4} s after the creation of intracellular anoxia establishing this time as an upper limit to the lifetime of the species. Unusual behaviour of the diffusion curve observed for longer delay times can be explained by a model wherein it is postulated that a radiation-induced inhibiting agent slows down diffusion. Application of this model to the experimental data yields a value of 0.4×10^{-5} cm^2 s^{-1} for the cellular oxygen diffusion coefficient. Similar experiments recently carried out for Serratia marcescens will also be described. The oxygen effect in cultured HeLa cells exposed to single short electron pulses has been examined over a range of oxygen concentrations. A family of breaking survival curves was obtained similar to those previously measured for E coli B/r by this laboratory. The data appear to be reasonably consistent with a physicochemical mechanism involving the radiochemical depletion of oxygen previously invoked for bacteria. (auth)

29583 INFLUENCE OF THE MECHANICAL AND DENSITOMETRIC PROPERTIES OF BONE BY RADIATION STERILIZATION. Amosov, I. S.; Sveshnikova, A. A.; Utenkin, A. A.; Modaeva, E. V. (Research Inst. of Medical Radiology, Obninsk, USSR). Radiobiol. Radiother.; 16: No. 6, 687-695(1975). (In German)

In the present paper strength and elasto-plastic properties as well as mechanical anisotropy of radiation sterilized bone-grafts immediately after irradiation with doses of 1×10^5–1.5×10^6 rd were studied. For that microroentgenological examinations for the elucidation of eventual changes in the irradiated bone-tissue were made. For the valuation of the mechanical properties the following parameters were chosen: elasticity modulus, limit of strength, proportionality limit, elastic limit deformation and maximum destruction deformation. As material of examination under the effect of compression pressure bone samples from the middle third of the human femur were used which had been sawed out in the angles: 0° (longitudinal), 45° (diagonal) and 90° (transverse) relative to the diaphysial longitudinal axis. Furthermore, bone samples from the middle tibia of rabbits and whole shinbones were used for microroentgenographic examinations. The analysis of the experimental results revealed that the effect of ionizing radiation mainly manifested in a decrease in the mechanical bone properties. Minimum changes occurred after absorbed doses of about 2.5×10^5 rd especially in longitudinally orientated bone samples. (auth)

29584 CHANGE OF TOXIC PROPERTIES OF ENDOTOXINS OF THE FAMILY OF ENTEROBACTERIACEAE AFTER THE EFFECT OF γ-RAYS. Tumanyan, M. A.; Duplishcheva, A. P.; Sinilova, N. G.; Ivanov, K. K. (Inst. of Epidemiology and Microbiology, Moscow). Radiobiol. Radiother.; 16: No. 6, 697-703 (1975). (In German)

The effect of γ-rays with doses of 1 to 10 mrad to the toxis and biological properties of endotoxins was examined which was produced from different microorganisms of the family of enterobacteriaceae. The effect of ionizing radiation was found to lead to a suppression of the toxic properties of endotoxins for all microorganisms examined which is probably connected with the change of the lipoid component of the endotoxin molecule. The suppression of toxicity in the maintenance of the immunogenic and antigenic properties of the 0-(body)-antigen of abdominal typhoid bacteria by the irradiation with a dose of 3 mrad can be applied for the production of intestinal vaccines with suppressed toxicity. (auth)

29585 METHOD FOR DETERMINING TRANSCRIPTIONAL LINKAGE BY MEANS OF INHIBITION OF DEOXYRIBONUCLEIC ACID TRANSCRIPTION BY ULTRAVIOLET IRRADIATION: EVALUATION IN APPLICATION TO THE INVESTIGATION OF IN VIVO TRANSCRIPTION IN BACTERIOPHAGE T7. Brautigam, A. R. Boulder, CO; Univ. of Colorado (1975). 130p. University Microfilms Order No. 75-23,569.

Thesis (Ph. D.).

A technique for mapping promotor sites (sites at which DNA-dependent RNA polymerase binds to DNA and initiates the synthesis of RNA) is presented. It utilizes the introduction of transcription-terminating lesions in DNA through uv irradiation which prevents transcription of genes in proportion to their distance from the promotor. This technique was applied to and evaluated in investigations of the transcriptional linkage of bacteriophage T7. All results substantiate the hypothesis that transcription in vivo does not proceed beyond the first uv lesion encountered in the template DNA and that such premature termination of transcription is the principal effect of the uv irradiation on the transcriptional template function of DNA. UV-induced inhibition of the initiation of transcription is insignificant by comparison. UV inactivation of expression of individual T7 genes was found to follow pseudo first-order kinetics, allowing a gene-specific uv inactivation cross section to be evaluated for each gene. The cross section was found to vary linearly with physical map position of genes within each transcription unit. Promotor locations were inferred from the discontinuity in the numerical values of inactivation cross sections arising at the start of each new unit. By such analysis the bacteriophage T7 genome was found to consist of seven transcription units. In vivo E. coli RNA polymerase transcribes the T7 early region as a single unit from a promotor region located at the left end of the genome. No other promotor on the T7 genome is recognized by E. coli RNA polymerase in vivo. The T7 late region, which is transcribed by T7-induced RNA polymerase, was found to consist of six transcription units with promotors located just ahead of genes 1.7, 7, 9, 11, 13 and 17. The late transcription units coding for structural proteins were found to overlap, such that transcription initiated in a proximal unit is continued through distal units, with termination deferred until the end of the genome.

29586 EFFECTS OF COMBINED TREATMENTS ON THE RADIOSENSITIVITY OF ASPERGILLUS FLAVUS AND PENICILLIUM ISLANDICUM. Choi, E. H.; Lee, S. R. Han'guk Sikp'um Kwahakhoe Chi; 7: No. 3, 154-158(1975). (In Korean)

Effects of combined treatment of radiation-heat and radiation-chemicals on the survival of mycotoxin-producing molds Aspergillus flavus and Penicillum islandicum conidia were investigated. Combined treatments of γ radiation and heat (10 minutes at 50°C or 55°C) showed a synergistic effect, causing remarkable decreases in D_{10} values and induction doses in the two molds. Combined treatments of γ radiation and chemicals (sorbic acid) had no synergistic effect. Asp. flavus was more resistant to heat and sorbic acid than was Pen. islandicum. (Korean Sci Abstr.)

29587 STUDIES ON THE PRESERVATION OF POTATO BY COMBINATION OF γ-RADIATION AND CHEMICAL. Kim, S. K.; Park, N. P. Han'guk Sikp'um Kwakakhoe Chi; 7: No. 3, 159-167 (1975). (In Korean)

Present work was conducted to investigate the combined effects of γ-radiation and chemical treatment on the inhibition of sprouting and decay of potato tubers. Irish Cobbler, Apollo, and Shimabara potato tubers were immersed in 1000, 2000, and 3000 ppm solution of salicylic acid for 2 minutes, and then irradiated at doses of 5, 10, and 15 krad using an indoor γ room of approximately 10,000 Ci of ^{60}Co. Treated tubers were stored for 8 months at room temperature. (Korean Sci Abstr.)

Radiation Effects on Plants

Refer also to abstracts 29572.

29588 INDUCED MUTATION IN TOMATO BY POST-IRRADIATION TREATMENT WITH COLCHICINE AND DIETHYL SULPHATE. Bose, S.; Maiti, S. N. (Calcutta Univ. (India). Coll. of Agriculture). Indian Biol.; 6: No. 1, 69-73(Apr 1974).

Dry seeds of tomato were first treated with radiation doses 10, 20, 30, and 40 kR of x rays and then treated with distilled water, colchicine (0.2% solution) and diethyl sulphate (saturated solution), in each case separately for 24 hours. Chromosome aberrations, genetic damage, mutation frequency and mutation spectrum were recorded and discussed. (INIS)

29589 STUDIES ON RADIATION INDUCED MORPHOLOGICAL MUTANTS IN SESAMUM ORIENTALE (L). Nayar, G. G. (Bhabha Atomic Research Centre, Bombay (India). Biology and Agriculture Div.). Trans. Bose Res. Inst.; 33: No. 2, 41-53(1970).

The agronomic characters of four x-ray induced morphological mutants in S. orientale L. viz WFM, SSM isolated from var. T16 (black seeded) and SSM_2 and Chlo. mut. isolated from var. T10 (brown seeded) were studied. WFM, SSM and SSM_2 showed early

sprouting and increased growth while the Chlo. mut. showed delayed germination and growth. The mean leaf size, plant height and number of branches were greater in WFM and SSM as compared to T16. The mean time of flowering was early in SSM and SSM_2 while it was late in WFM and the Chlo. mut. as against their respective parents; the differences were significant. In mean yield of fruits per plant, WFM and SSM were superior to T16. A large scale trial has indicated that the seed yield in the mutants WFM, SSM and SSM_1 was slightly higher than their parents. WFM, SSM and SSM_2 showed an increase in oil content, the increase in SSM and SSM_2 being 6 to 10 percent. The quality of oil as indicated by color and peroxide value (keeping quality) was also superior in WFM and SSM. The development of three flowers per node in SSM (otherwise solitary and axillary), two from modified nectary glands on either side of the leaf, provides some information on the phylogeny of the nectary glands and would appear to be of some economic significance. (auth)

29590 INFLUENCE OF IONIZING RADIATION ON MICROSPOROGENESIS IN RYE (SECALE CEREALE L.). Pt. 1 Ochlewska, M. (Szkola Glowna Gospodarstwa Wiejskiego, Warsaw (Poland)). Hodowla Rosl., Aklim. Nasienn.; 18: No. 2, 151-162 (1974). (In Polish).

The influence of various doses of gamma radiation on microsporogenesis in rye was investigated. Changes were observed in various phases of meiosis in plants belonging to one clone. The influence of radiation was most pronounced in anaphase I and II in the form of numerous chromatid aberrations. The incidence of these disorders increased with the dose both in anaphase I and in anaphase II. In anaphase I the frequency of noticeable disturbances was higher in material irradiated in earlier phases. Probably it increased proportionally to the time of exposure of the cells in meiotic prophase to radiation. The material examined in anaphase II did not show significant differences in the frequency of disturbances in cells irradiated for 2.5 to 0.5, 3 to 1 and 4 to 2 h before anaphase II. Probably interkinesis was affected by exposure. On the other hand, in material irradiated for 5 to 3 h the frequency of disturbances was statistically significantly higher. It is possible that in this case exposure involved prophase I. (auth)

29591 EFFECT OF IONIZING RADIATION ON AMYLASE ACTIVITY IN MAIZE SEEDLINGS. Szoke, P. N.; Sirohi, G. S. (Indian Agricultural Research Inst., New Delhi. Div. of Plant Physiology). Indian J. Plant Physiol.; 17: No. 1, 58-60(1974).

Effect of ionizing radiation on amylase activity in the seeds of high yielding maize hybrid var. Ganga-5 was investigated. Gamma radiation doses varying from 500 to 30,000 R were used to treat the seeds prior to germination. The seeds were germinated for 96 hr and amylase activity was determined periodically. The results showed significantly high activity at 24 hr in seeds exposed to 1000 R. The amylase activity was stimulated even at high doses of 10,000 R. (auth)

29592 INDUCED QUANTITATIVE MUTATIONS IN OKRA (ABELMOSCHUS ESCULENTUS MOENCH). I. Plant Height Mutations. Yashvir (Meerut Univ. (India). Div. of Plant Science). Proc. Indian Acad. Sci., Sect. B; 81: No. 4, 181-185(Apr 1975).

Mutations induced by gamma rays, ethyl methane sulphonate and diethyl sulphate in Okra (Abelmoschus esculentus) variety Pusa Sawani are reported. In M_2 generation variance increased at the lower doses, but considerably decreased at high doses. The increased variability is mainly due to micromutation. More variability is released in treatments of EMS and DES than gamma rays. (auth)

29593 MODIFYING EFFECT OF DYNAMIC SPACE FLIGHT FACTORS ON RADIATION DAMAGE OF AIR-DRY SEEDS OF CREPIS CAPILLARIS /L/ WALLR. Vaulina, E. N.; Kostina, L. N. pp 167-172 of Life Sciences and Space Research. XIII. Berlin; Akademie-Verlag GmbH (1975).

From proceedings of the seventeenth plenary meeting; Sao Paulo, Brazil (17 Jun 1974).

The influence of dynamic factors (vibration and linear acceleration) on the rate of chromosome aberrations in Crepis capillaris was studied. The vibrational process simulated was similar in its characteristics to that occurring at the launch of spaceships. In combination with linear acceleration it caused a statistically significant increase in the rate of chromosome aberrations compared with the control (R = 7.70). The dynamic factors modified the effect of radiation damage induced by acute gamma-irradiation (3 krad). Pre-radiation treatment with vibration and acceleration on the seeds caused a significant decrease (R = 10.23) in the effect of radiation damage, from 15.57% to 9.74%. The post-radiation treatment of C. capillaris seeds with the dynamic factors did not change the rate of chromosome aberrations significantly (from 15.57% to 15.90%). (auth)

29594 RADIOSENSITIVITY STUDIES WITH WOODY PLANTS. III. Predictions of Limits of Probable Acute and Chronic LD_{50} Values from Lognormal Distributions of Interphase Chromosome Volumes in Gymnosperms. Sparrow, A. H.; Schwemmer, S. S.; Thompson, K. H. (Brookhaven National Lab., Upton, NY). Radiat. Res.; 65: No. 2, 315-326(Feb 1976).

The application of lognormal frequency distributions (the logarithm of the original variate is distributed normally) in establishing the range of various nuclear parameters including interphase chromosome volume (ICV) and DNA per chromosome has been demonstrated for a large number of gymnosperm taxa (236 spp.). Parameters from the plot of the probit of cumulative frequency vs log ICV (based on lognormal distributions, and using the known correlations between ICV and acute and chronic whole-plant radiosensitivity) permit the prediction of the probable limits of radiosensitivity for all unsampled species for a given taxonomic group. Similarly, the range of predicted radiosensitivities for species having ICV's above or below any given value may be estimated from the plots, probit of cumulative frequency vs log ICV. The lognormal distributions of ICV and derived probable limits of acute and chronic LD_{50}'s are given for many species of six gymnosperm families including the Pinaceae, Cupressaceae and Podocarpaceae, and separately for six genera of these families. General predictions of radiosensitivity are made for other gymnosperm families represented by fewer species. The feasibility of using the probit of cumulative frequency-log ICV approach is discussed with regard to the prediction of radiosensitivities on a broad scale in other taxonomic groups for which DNA per chromosome or ICV data are available. (auth)

29595 MODE OF INHERITANCE OF IRRADIATION INDUCED DWARFISM AND MALE STERILITY IN THE TOMATO, LYCOPERSICON ESCULENTUM. Garofalo, J. F. Baton Rouge, LA; Louisiana State Univ. and Agricultural and Mechanical Coll. (1975). 87p. University Microfilms Order No. 76-145.

Thesis (Ph.D.).

Seedlings of the Louisiana tomato cultivar "Pelican" were irradiated in the cotyledonary stage with 10,000 roentgen (R) of gamma radiation from ^{60}Co at 1.67 R/min by Dr. Milton J. Constantin, Comparative Animal Research Laboratory operated by the University of Tennessee for the Atomic Energy Commission. From these irradiated plants one dwarf and six stamenless mutants were selected and propagated. In 1973 to 1974 a genetic study was conducted to determine the mode of inheritance of these mutant characters. Also a combining ability study was conducted to determine the potential value of the dwarf mutant as a parent in the production of F_1 hybrid seed. The results of the genetic study showed that the induced dwarf character was simply inherited and recessive. Results indicate that this gene is probably located at a locus different from that of genes controlling dwarfism in other tomato lines. The combining ability study showed that this dwarf mutant is of little value as a breeding parent. The genetic study of the stamenless lines showed this character to be simply inherited and recessive. It was also shown that the gene controlling male sterility is located at the same locus in the lines L 39 and L 43, and it is assumed that the same locus is involved in all six lines. The stamenless lines have, as far as has been observed, retained the good combining ability of the original parent cultivar "Pelican". (Diss. Abstr. Int., B)

29596 INDUCED PARTHENOCARPY WITH POLLEN IRRADIATED WITH GAMMA RAYS. Dryanovska, O. A. (Central Lab. of General Genetics, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 9, 1273-1376(1975).

Pollen was collected from tomatoes, cucumbers, and melons and treated with gamma radiation in doses up to 500 kR. Flowers were pollinated with irradiated and control pollen. The experimental fruits did not differ in size and shape from controls when the radiation dose did not exceed 100 kR; with higher doses the experimental fruits were smaller. Fruits obtained from irradiated pollen contained degenerated seeds. Results indicated that parthenocarpy induced by radiation was the result of the initial impulse toward development received by the embryo and endosperm.

29597 EXAMINATIONS ON THE SPECIFIC EFFECT OF LOW DOSES OF IONIZING RADIATIONS ON CULTIVATED PLANTS. Degner, W.; Schacht, W.; Knuepfer, H. (Humboldt Univ., Berlin). Radiobiol. Radiother.; 16: No. 6, 705-710(1975). (In German)

In 1972 several kinds of silo maize were tested in allotment experiments at 6 different places with absorbed dose rate of 4 rd/min and in 1973 with 57.5 rd/min. A ^{60}Co-γ-irradiation of the dry seed was found to result in increased crops of dry mass and of crude protein. These increased crops are higher than was expected by the green mass values. Maximally increased crops of crude protein of 45% and increased crops of dry mass of 36% were achieved. With the used absorbed doses of 50 rd and 200 rd

the absorbed dose rate of 4 rd/min yielded the better results compared to the higher dose rate of 57.5 rd/min. Current experiments should clarify whether this is a systematic result or other parameters not being considered are responsible for these results. (auth)

29598 MOLECULAR ASPECTS OF BIOLOGICAL ENERGY AND ELECTRON TRANSPORT: PHOTOSYNTHESIS. Land, E. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 135-146 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

Pulse radiolysis and flash photolysis have been applied to chemical systems involved in biological energy and electron transport processes. The processes of particular interest are those that take place in mitochondria (i.e., oxidative phosphorylation), in chloroplasts (i.e., photosynthesis) and in photo-receptors (i.e., vision). Pulse radiation techniques can be applied either to the intact biological membranes (see, for example, Witt, Quart.Rev. Biophys.; 4:365 (1971)), or to simple solutions of individual components of the various excitation and electron transport chains. The two approaches are complementary. In this paper a description is given of some data obtained from simple solutions which are helpful in interpreting information similarly gained from intact photosynthetic membranes, and hence in understanding certain aspects of photosynthesis. (auth)

29599 DISPLAY OF TWO REACTION PATTERNS AFTER EXPOSURE OF BARLEY SEEDS TO γ RADIATION OF ^{60}Co IN AIR. Silvy, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France). Service de Radio-Agronomie). C. R. Hebd. Seances Acad. Sci., Ser. D; 281: No. 12, 799-802(22 Sep 1975). (In French)

Barley seeds with 10.5% water content have been exposed in air to radiation of ^{60}Co. The height of the first leaf of the seedlings when it has stopped growing shows the division of the initial population into two sub-populations that advance independently of one another. Owing to this phenomenon it is possible to take a new view of radiobiological studies of seeds. (FR)

29600 SPECIFIC INCREASE, BY X-RAYS, OF DARK CARBON DIOXIDE OUTPUT FROM LEAVES OF PELARGONIUM ZONALE L. de Bock, F.; Carlier, G. (Grenoble-1 Univ., 38 (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 281: No. 14, 993-996 (6 Oct 1975). (In French)

Following irradiation by x rays, carbon dioxide output of leaves of Pelargonium zonale L. is increased only in the dark. A temporary lighting delays the setting up of this increase. In the light neither photorespiration, nor carbon dioxide output is changed by x-ray irradiation. (FR)

29601 INDUCED POLLEN STERILITY IN PETUNIA. Mode of Inheritance and Tapetal Behavior. Singh, I. S. (Institut National de Recherches Agronomiques (INRA), 21-Dijon (France). Station d'Amelioration des Plantes). Ann. Amelior. Plantes; 25: No. 3, 303-319(1975).

A study was undertaken to investigate the characteristics of different mutants for induced pollen sterility in Petunia hybrida Hort. The F_1 hybrid zygotes (Tl-h_1-x Sf-1a γ) were exposed to a 0.2% solution of ethyl methane sulfonate and to 0.75 kR of ^{60}Co γ rays. Their seeds were sown and pollen sterile plants were observed in the M_1. The pattern of inheritance in the F_2 and the backcrosses of some selected pollen sterile M_1 mutants showed that sterility mutations had been induced. Whether the mutations are recessive or dominant is not yet known, but it has been shown that they act through the sporophytic tissues. Morphological and cytological observations on four highly sterile M_1 plants showed a similar abnormal behavior of the tapetum. The tapetum of the pollen sterile anthers was thicker, more vacuolated and did persist until a later stage than those in fertile anthers. It is suggested that the persistence of the tapetum after a certain stage blocks the trophic process required for the development of the microspore into viable pollen, and the cause of pollen abortion is sporophytic even when no inheritance of the sterility is observed. (FR)

29602 INDUCTIVE EFFECT OF LOW DOSES OF γ RADIATION ON THE BIOSYNTHESIS OF ASCORBIC ACID AND SULFHYDRYL COMPOUNDS. Chinoy, J. J.; Gurumurti, K.; Singh, Y. D. (Gujarat Univ., Ahmedabad, India). Indian J. Plant Physiol.; 16: No. 1-2, 42-49(1973).

The radiation-induced changes in the ascorbic acid, (AA), ascorbigen (ASG) and sulfhydryl (SH) contents as well as in dry matter production have been investigated in the embryo axis and endosperm of wheat seedlings raised from seeds subjected to low doses of γ rays. AA and SH contents increased in the embryo axis of irradiated seeds. The level of ASG in irradiated tissues was low suggesting the release of free AA in the system. It is postulated on the basis of this experimental evidence that the low doses of γ radiation trigger the biosynthesis of AA and SH in the growing embryo axis, a part of which is utilized for protecting the tissue from damage and the rest in stimulating the metabolism and consequently the growth. (Indian Sci. Abstr.)

29603 INDUCTION OF CHANGES IN THE FLOWERING TIME OF RICE AFTER X-RAY AND ^{32}P TREATMENT. Majumdar, B. (Bose Research Inst., Calcutta (India). Dept. of Botany). Trans. Bose Res. Inst.; 35: No. 2, 31-35(1972).

The effect of X-rays and ^{32}P on the flowering time of rice was studied. Four varieties of rice, namely, Dular, Marichbatie, Jhanjee, and Satika were treated with different doses of X-rays and ^{32}P and periods taken for flowering were analysed statistically. It was observed that most of the varieties after X-rays and ^{32}P treatments showed tendencies to increase the mean time of flowering. The range of flowering time was observed to be different in different varieties. (INIS)

29604 INDUCED MUTATIONS FOR IMPROVING QUANTITATIVE CHARACTERS OF GROUNDNUT. Patil, S. H. (Bhabha Atomic Research Center, Bombay). Indian J. Genet. Plant Breed.; 32: No. 3, 451-459(1972).

The X-ray induced large pod mutant was crossed to the Spanish parent as well as to the virescent mutant with a view to combine useful characters. Genetic studies on 11 characters in F_2 and F_3 generations showed that these characters were controlled by quantitative genes. Increased branching; leaflet length and kernel size, however, was unlike F_1 expression, perhaps, due to modifying factors influencing large pod character. Heritability values representing the amount of genetic variance available for selection, was more than 40% for all the characters excepting for yield, which had negligible variance. Hence direct selection for improved yields was not successful. Economically important characters such as shelling %, kernel size and oil content were less influenced by environment. Therefore it was easy to stabilize selection in them. Phenotypic correlations showed disadvantageous associations between kernel size/oil content and pod size/shelling % resulting in a limited scope for selecting plants having large kernel with increased oil content and improved shelling %. In spite of these associations, a few selections having large kernels, improved oil content and increased shelling % were isolated in the cross between the two mutants. This indicated the advantages of cross-breeding among the induced mutants.

29605 EXTENT OF NATURAL OUTCROSSING IN X-RAY INDUCED MUTANTS OF RICE. Naraharl, P. (Bhabha Atomic Research Center, Bombay). Indian J. Genet. Plant Breed.; 32: No. 3, 349-352(1972).

Natural outcrossing in x-ray induced rice mutant was determined by the frequency of heterozygous plants in each progeny of the M2 mutants. Abnormally high values of natural outcrossing, even amounting to 100% on an individual plant progeny basis, was obtained. The results suggest that in order to ascertain the breeding behavior of the induced mutants in the very next generation, all mutants segregating in M2 should be selfed, even in self-pollinated crops. (Indian Sci. Abstr.)

29606 EFFECT OF γ RADIATION ON SOME MEMBERS OF ACANTHACEAE. Kaur, J.; Nizam, J. (Osmania Univ., Hyderabad, India). J. Indian Bot. Soc.; 51: No. 3-4, 226-231(1972).

Seed material belonging to seven genera of Actanthaceae was subjected to γ irradiation at 2 different intensities - 55 rads/min. and 25 K rads/min being the dose rate for low and high intensity irradiation respectively the effect of low intensity irradiation in both acute as well as fractionated doses and high intensity irradiation was observed. The effect of storage on seeds treated with high intensity irradiation was also noted. Barleria prionitis is the most sensitive to irradiation. This sp. has the highest chromosome number and the largest chromosomes among the sp. investigated. From the seeds treated with high intensity irradiation, only a few seeds of Rhytilymma glaucum and Asteracantha longifolia treated at the lowest dose i.e., 10,000 rads, germinated and survived up to maturity. There was however, no abnormality in the meiotic behavior of the pollen mother cells of the surviving plants. (Indian Sci. Abstr.)

29607 FREQUENCY OF MUTANTS IN RICE IN RELATION WITH FLOWERING TIME. Majumdar, B. (Bose Inst., Calcutta). Indian J. Agric. Res.; 7: No. 3-4, 199-200(1973).

Dry seeds of rice varieties Dular, Marichbati, and Jhanjee were treated with different doses of x rays (25 KR, 50 KR, and 75 KR). The treated seeds were sown in the field along with their respective control. Mutants were isolated from second genera-

tion population. Results indicate that the frequency of induction of albino, xantha, and morphological mutants in rice after x-ray treatment shows that they are inversely proportional to duration of flowering time. (Indian Sci. Abstr.)

Radiation Effects on Animals

Man

Refer also to abstracts 29518, 29525, 29817, 29862, 31972, and 31978.

29608 (AED-CONF-75-244-011) THE RISK OF GENETIC HAZARDS IN MEDICAL APPLICATIONS. Stephan, G. (Bundesgesundheitsamt, Neuherberg/Muenchen (F.R. Germany). Inst. fuer Strahlenhygiene). 1975. 11p. (In German). INIS.

From 16th annual meeting of the Vereinigung Deutscher Strahlenschutzaerzte; Kiel, F.R. Germany (20 Jun 1975).

1 fig.; 4 tabs.; 20 refs. Available from ZAED.

The mutagenic action of ionizing radiation in humans is discussed, and a relationship is established between the absorbed dose and the genetic effects. The incidence of mutations is estimated on the basis of statistics. Results of animal experiments (mice) are referred to in order to estimate the ratio of absorbed dose to mutation frequency in humans. The rate of mutations induced per dose unit is a function of the germinal state and of the acute or chronic radiation exposure. Chronic radiation exposure of humans is connected with increased frequency of miscarriages, stillbirths, and genetic damage of the descendants. Diagnostic use of ionizing radiation is a negligible risk to the individual. (DE)

29609 (INIS-mf-1881) INTERCOMPARISON BETWEEN THE CALCULATED DOSE DISTRIBUTION AND THE MEASUREMENT WITH ^{7}LiF THERMOLUMINESCENT DOSIMETERS IN A TUMOR OF THE BLADDER. de Araujo, A. M. C. (Rio de Janeiro Unit. (Brazil). Instituto de Biofisica). 1974. 103p. (In Portuguese). INIS.

For the central plane of an assumed malignant tumor of the bladder, Cobalt-60 treatment plans were calculated from published isodose curves. The calculation was done for the three field technique, unbalanced and balanced, and for 120° rotational therapy with wedge filter. A "Rando-Alderson" phantom and calibrated encapsuled ^{7}LiF dosimeters with a standard deviation better than 3% of each were used to verify the treatment plans. Furthermore the dose distribution to an assumed extension of the tumor and to the rectum were measured. Comparison of calculated treatment plans and measured dose distributions demonstrated good agreement. Measurements show also that better homogeneity of the dose distribution were reached with rotational therapy. Furthermore, the measurements gave satisfactory homogeneity of the whole tumor volume, supporting the use of treatment plans just calculated for the central plane. Also in regard to the whole volume of tumor, rotational therapy appears to be superior to fixed field therapy. (INIS)

29610 (N-75-31723) RESEARCH PROGRESS IN RADIOBIOLOGY. Annual Research Report, 1 July 1973-30 June 1974. (Armed Forces Radiobiology Research Inst., Bethesda, Md (USA)). 30 Jun 1974. 151p. NTIS.

Contributions in the area of biomedical research and radiobiology are summarized. Biological data relevant to nuclear combat operations is provided with emphasis on use of nuclear weapons in tactical and theater nuclear warfare. (GRA)

29611 (NCRP-45) NATURAL BACKGROUND RADIATION IN THE UNITED STATES. (National Council on Radiation Protection and Measurements, Washington, D. C. (USA)). 15 Nov 1975. 163p. NCRP Publications, Washington, DC.

The National Council on Radiation Protection and Measurements (NCRP), successor to the National Committee on Radiation Protection and Measurements, has embarked on a program to examine and evaluate the many private studies and government programs related to sources of ionizing radiation that may contribute to the overall exposure of the population. The first in a series of reports envisioned under this program is concerned with the assessment of the radiation dose to the population from natural background radiation. Included in this report are the absorbed doses to the population due to radiation from cosmic sources, radionuclides in the earth, internally deposited radionuclides, inhaled radioactivity, and fallout from nuclear weapons tests. (CH)

29612 (NP-20847) RADIATION HEALTH AND SAFETY. Annual Report for the Year Ended 31st December 1974. (New South Wales Univ., Kensington (Australia)). 1974. 17p. Dep. NTIS (US Sales Only) $3.50.

Radiation protection procedures in New South Wales are outlined and an account is given of radiation incidents during 1974. Personnel monitoring and disposal of radioactive waste are briefly described. (auth)

29613 (RB/B/N-3496) USERS GUIDE TO THE POPDOS PROGRAM FOR EVALUATING COLLECTIVE DOSES. Henning, M. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Sep 1975. 25p. Dep. NTIS (US Sales Only) $3.50.

A complete description is given of the input data needed to use the computer program POPDOS for estimating collective doses to the population of England and Wales following atmospheric releases of radioactivity. Details are given of the Job Control Language used for normal execution of the program. A complete test case is included to facilitate program transfer to other computers. POPDOS is written in Fortran IV (level H) and is compiled under OPT-2, using ASP3 on the IBM 370/168 computer. A list of subroutines and their functions is given together with a tabulation of the major dimensioned variables. Finally there is a description of the procedure by which a collective dose surface can be generated using the CALCOMP plotting facilities. (auth)

29614 A PATH TO SPATIAL IRRADIATION PLANNING. Pt. 1. The Problem of the Dose Homogeneity Within the Area of Crossing Ray Beams With Different Planes of Incidence; Basic Examinations Leading to an Optimation Procedure. Sonntag, A. (Ulm Univ. (F. R. Germany). Dept. Radiologie). Strahlentherapie; 150: No. 5, 507-520(Nov 1975). (In German)

4 figs.

Under certain circumstances, foci within distinct regions of the body are optimally included by irradiation from different directions of the space. In practice, such plannings mostly fail from the difficulty to produce a sufficiently homogeneous dose distribution within the target volume. The present considerations disclose the possibility to determine certain parameters of irradiation in an explicit form, based on a vectorial view of the dose distribution, thus obtaining homogeneity of the radiation dose. Part I of this paper is presenting the foundations of a procedure which aims at dose homogeneity in cross-fire techniques with different planes of incidence, utilizing simple mathematical correlations among the vectorial dose quantities. (DE)

29615 METHODOLOGICAL INVESTIGATIONS FOR THE OPTIMIZATION OF COBALT-60 TELETHERAPY COMBINED WITH HIGH-DOSAGE BRACHYTHERAPY FOR CARCINOMA OF THE UTERINE CERVIX. Heckenthaler, W.; Binder, W. (Vienna Univ. (Austria). Strahlentherapeutische Klinik; Vienna Univ. (Austria). Inst. fuer Klinische Strahlenbiologie). Strahlentherapie; 150: No. 5, 475-486(Nov 1975). (In German).

16 figs.; 19 refs.

After dosimetric recording of the radium implants being in use at the radiological department of the gynecological clinics at Vienna, an attempt is made for the adaptation of cobalt-60 teletherapy to brachytherapy generally applied here and utilizing relatively high dosage. A biaxial, bisegmental small-angle rotation about two cranially convergent axes, combined with the radium doses, yields a relatively well equilibrated load on the parametrial tissue and on the essential areas of the lymph flow. The dose distribution is shown by transversal as well as by frontal sectional planes. If deviations of the position of the radium implants, always possible in an individual case, are verified by localization imaging, asymmetrical dose distributions can be calculated by a computer and compensated by means of different loads to the axes of rotation. (DE)

29616 PRINCIPLES FOR THE OPTIMIZATION OF IRRADIATION PLANNING. Popp, F. A.; Bothe, B.; Goedecke, R. (Marburg Univ. (F. R. Germany). Radiologiezentrum). Strahlentherapie; 150: No. 4, 389-402(Oct 1975). (In German)

6 figs.; 1 tab.; 12 refs.

Theoretical studies, data from radiation biology, and clinical experiences reveal that the tissue capability of recovery is susceptibly dependent on communication phenomena in the cellular association. Little is known so far of the interrelations. Most simple suppositions, however, lead already to plain criteria of optimization for the spatial dose distribution and to practical conclusions with regard to dosage and fractionation. (DE)

29617 PERSISTENT CHROMOSOME ABERRATIONS FOLLOWING A RADIATION ACCIDENT. Todorov, S. (Meditsinska Akademiya, Sofia (Bulgaria). Tsentyr po Zarazni i Parazitni Bolesti). Acta Med. Bulg.; 2: No. 1, 58-63(1974).

Analysis of structural chromosome aberrations in peripheral blood lymphocytes from two persons 10 months after being directly involved in an accident with radium-226 is carried out. Summarized data from control cultures worked out over the past two years in the laboratory, including the present study, show that the spontaneous incidence of structural chromosome aberrations amount to 2% chromatid fragment, 0.25% chromosome

fragments, 0% dicentrics and other structural aberrations or 2.25% aberrant cells which overlap the results reported by other authors. Lymphocyte cultures are fixed 52 and 72 hours after stimulation with phytohemagglutinin. Comparative evaluation of the results show a definite tendency towards a decrease of all patterns of chromosome damages parallel to the prolongation of cultivation time which underlines the importance of discounting the cultivation up to the 52nd hour for cytogenetic analysis both after irradiation in vitro and in vivo. In comparison with the data from the cytogenetic analysis immediately after the accident the present study shows a mean reduction of all types of chromosome aberrations about 30% ± 3.1%. Besides the application for the purposes of "biological dosimetry" the cytogenetical analysis of accidentally irradiated persons may give direct evidence concerning the possible biological implications of persistent chromosome aberrations, as related to the cancerogenesis, as well as in other long-term effect of radiation. (INIS)

29618 CRITERIA FOR AN OPTIMAL ISOTOPE TO BE USED IN GYNECOLOGIC RADIATION THERAPY. Walstam, R. (Radiofysiska Institutionen, Stockholm (Sweden)). Strahlentherapie; 150: No. 3, 258-260(Sep 1975). (In German)

1 fig.; 2 tabs.; 4 refs. Lecture from the Symposium on Afterloading Techniques, Wuerzburg 1974.

With regard to the evident disadvantages of radium, nowadays an artificial radiation source always should be considered, since it may be much more favorable for any intracavitary application. The most usual ones are Cs-137, Co-60 and Ir-192. Each of these isotopes has its advantages and disadvantages; therefore the choice of the isotope must take into account the criteria and requirements for each intracavitary radiation technique. (DE)

29619 CONSIDERATIONS ON BIOLOGICAL RADIATION EFFECTS INFLUENCING THE CHOICE OF THE DOSE-RATE IN INTRACAVITARY RADIOTHERAPY. Trott, K. R. (Muenchen Univ. (F. R. Germany). Strahlenbiologisches Inst.). Strahlentherapie; 150: No. 3, 261-266(Sep 1975). (In German)

4 figs.; 5 refs. Lecture from the symposium on afterloading techniques, Wuerzburg 1974.

The differences in the biological effects of either fractionated high dose-rate irradiation or protracted low dose-rate irradiation is discussed with regard to their relevance for intracavitary radiotherapy. There is no biological advantage in using fractionated high dose-rate irradiation instead of protracted low dose-rate irradiation. However, with adequate fractionation schedules, fractionated high dose-rate intracavitary radiotherapy may be as good as radium therapy. (DE)

29620 SIGNIFICANCE OF THE AFTERLOADING METHOD FOR RADIATION PROTECTION. Henseler, H. (Bayerisches Landesamt fuer Umweltschutz, Muenchen (F. R. Germany)). Strahlentherapie; 150: No. 3, 243-250(Sep 1975). (In German)

6 figs. Presented at the "colloquium on afterloading techniques," Wuerzburg 1974.

The significance of the afterloading method for the improvement of radiation protection is illustrated, and the resulting simplifications of constructional and operational radiation protection measures are discussed with a special stress on the possibility of completely dispensing with personnel monitoring of the persons working in the irradiation room with long-term and short-term dosemeters. (DE)

29621 ON THE THERAPY OF ACUTE RADIATION SYNDROME. Alekseev, G. I.; Kruglov, A. N. Voenno-Med. Zh.; No. 12, 33-36(Dec 1974). (In Russian)

The primary overall reaction of the organism to radiation is described and means are recommended for rendering pre-therapy and therapy help and also means of assistance when there is massive injury from an enemy's nuclear weapons. Means used for caring for the patient in the latent period of acute radiation sickness (ARS) are named. Indications for the use of antibiotics and treatment for prophylactically infectious complications are mentioned. The expediency of using transfused blood with ARS and the effectiveness of transplantation of bone marrow are discussed, and complications arising in ARS are described in detail. (INIS)

29622 THE INFLUENCE OF X-RAY IRRADIATION ON THE QUANTITY OF CHROMOSOME ABERRATIONS IN HUMAN PERIPHERAL BLOOD LYMPHOCYTES Todorov, S.; Milcva, M.; Bulanova, M.; Ivanov, B. (Meditsinska Akademiya, Sofia (Bulgaria). Tsentyr po Zarazni i Parazitni Bolesti). Acta Med. Bulg.; 2: No. 1, 97-104(1974).

The quantity of structural chromosome aberrations in lymphocytes of human peripheral blood, produced by irradiation with x rays in the dose range 25 R to 500 R, was studied. Lymphocytes cultures were prepared according to the microculture technique. Fixation was performed 52 hours after phytohemagglutinin stimulation. A relatively low incidence of spontaneous chromosome aberrations was found: 0.016 aberrations per cell entirely at the expense of a single break aberrations – 0.014 chromatid and 0.002 chromosomal fragments per cell. With increasing the dose the quantity of all types of structural chromosome aberrations were likewise increased with exception of the chromatid fragments. The amount of dicentrics was the greatest among the two break aberrations (60 to 70%), the other types of two break aberrations ranked after the dicentrics as follows: intestinal deletions, rings, chromosome exchanges and tricentrics. The relation between single and two break aberrations at different doses was determined. The mathematical model $Y - sD^n$ $(1 < n < 2)$ was proposed for description of the kinetics of two break aberrations, total number of aberrations and deletions. The yield of the chromosome fragments and aberrant cells was described by the model $Y = a + vD$. The possibility of utilization of several different cytogenetic criteria after elaboration of standard curves in solving the biological dosimetry problem was stressed. (INIS)

29623 VISUALIZATION OF VOLUMETRIC DOSE DISTRIBUTIONS IN AN IRRADIATED OBJECT. Kvasov, V. A.; Elibekov, S. G. (Inst. of Oncological Scientific Research, Moscow). Med. Radiol.; 20: No. 9, 62-66(Sep 1975). (In Russian)

The article describes the results of employing the methods of stereodrawing and stereoroentgenogrammetry for the vasualization of a volumetric dose distribution and for bringing it into coincidence with the irradiated object in space. To obtain volumetric perception of the dose distribution by means of a stereoscope, it is necessary to have the stereopair of the dose distribution, i.e., two central projections of it. The construction of stereoscopic projections of the volumetric dose distribution from a system of linear preparations in the treatment of cervical cancer on an Arat-B apparatus is considered as an example. The resultant data can be of considerable help in assessing the rationality of the radiation therapy method that is chosen. The question of automating the process of obtaining stereopairs by means of an electronic computer with result output on a graph plotter will be the subject of future studies by the authors. (JPRS)

29624 COMPARISON OF TREATMENT RESULTS WITH RADIOGOLD, COBALT-60-TELETHERAPY AND CHEMOTHERAPY IN 330 CARCINOMAS OF THE OVARY. von Fournier, D.; Kubli, F.; Kuttig, H.; Hinderer, H.; Drings, P. (Heidelberg Univ. (F. R. Germany). Frauenklinik). Strahlentherapie; 150: No. 3, 280-288(Sep 1975). (In German)

1 fig.; 10 tabs.; 8 refs.

From 1960 to 1972, 276 out of 330 cases of ovarian cancer were treated by different techniques of postoperative radiation therapy; 54 advanced cases underwent prospective chemotherapy. Radiogold intraabdominally administered (190 to 300 mCi), telecobalt (5,000 rd) or the combination of radiogold and telecobalt was chosen for postoperative radiation therapy. Cyclophosphamide (Endoxan), prednisolone, and gestagenes (Prothil) were given as a long-term chemotherapy. The most successful technique of radiation therapy is confronted with long-term chemotherapy after three years (five years) of survival: Stage I a, b, c: Radiogold = 91.7% (66.7%), chemotherapy (only I c) = 100%. Stage II a, b: Radiogold + telecobalt = 47% (35%), chemotherapy = 85%. Stage III: Radiogold + telecobalt = 25% (0%), chemotherapy = 52%. Stage IV: Radiotherapy = 0%, chemotherapy = 25%. The absolute five-year survival without chemotherapy amounted to 23%. The mortality curve under chemotherapy shows a four-year survival rate of 88%, if tumor cells had been detected microscopically (ascites, omentum), but of only 30% after macroscopical verification of the tumor. (DE)

29625 EFFECTIVENESS OF TREATMENT OF PATIENTS WITH PARALYTIC FORMS OF POLIOMYELITIS WITH RADICULAR SYNDROME BY MEANS OF MUD APPLICATIONS AND RADON BATHS. Keleinikov, G. T.; Petelin, S. M. Vopr. Kurortol., Fizioter. Lech. Fiz. Kul't.; 5: 419-421(1974). (In Russian)

Results are presented to show that mud bath and radon bath therapy in conjunction with therapeutic gymnastics, massage, and orthopedic measures are indicated for patients with paralytic forms of poliomyelitis with radicular syndrome. (JSR)

29626 STEEPNESS OF THE DOSE RESPONSE CURVE BOTH FOR TUMOR CURE AND NORMAL TISSUE INJURY. Stewart, J. G.; Jackson, A. W. (Christie Hospital, Manchester, Eng.). Laryngoscope; 85: No. 7, 1107-1111(Jul 1975).

At the Christie Hospital in Manchester, 4 MeV radiation was introduced in 1955. In consequence of a lack of knowledge of absolute dose definition and R.B.E. factor, patients were treated over a range of dosage. Three hundred fourteen patients with laryngeal cancer, treated over a time interval of three weeks, received doses over a range of 5000 rads to 5800 rads. Recurrence, morbidity and necrosis rates are plotted against dose. In

T_1 tumors there is very little variation in recurrence rate, and such tumors may be safely treated at the lower doses thus avoiding morbidity and necrosis. T_3 tumors, however, show a considerable variation in recurrence rate being 68 percent at the lower end of the range, dropping to 30 percent at the high end. Necrosis nil at the lower end rises to some 8 percent at the high end. The balance of advantage of tumor sterilization versus the disadvantage of normal tissue damage is discussed. (auth)

29627 RADIOIMMUNOASSAY FOR PLASMA CORTICOTROPIN IN FROGS (RANA ESCULENTA L.). Vaudry, H.; Vague, P.; Dupont, W.; Leboulenger, F.; Vaillant, R. (Laboratoire d'Endocrinologie, Monte-Saint-Aignan, France). Gen. Comp. Endocrinol.; 25: No. 3, 313-322(Mar 1975).

A radioimmunoassay technique has been developed for measuring frog plasma corticotropin (ACTH) without prior extraction. Using synthetic porcine ACTH as a reference standard, ^{131}I-labeled synthetic human ACTH (sp act greater than 500 mCi/mg) as tracer and rabbit anti-porcine ACTH serum, the lower measurable value was estimated at about 4 pg ACTH. Only human and porcine ACTH, ACTH, and frog pituitary ACTH reacted with the rabbit anti-porcine ACTH serum. No cross-reactivity has been found with synthetic ACTH, alpha MSH, and bovine beta MSH. Appearance of damaged ^{131}I-h ACTH components after storage in plasma solutions was followed for 7 days. The conditions making it possible to reduce ACTH damage have been ascertained. The average plasma corticotropin level (+- CI) was found to be 38.8 +- 7.8 pg/ml without any significant difference between males and females. These results suggest that frog ACTH secretion has much in common with mammalian secretions. (auth)

29628 IMMUNOCOMPETENT CELLS IN MAN. III. The Killer Cell Activity of Normal Circulating Lymphocytes. Behelak, Y.; Richter, M. (Univ. of Ottawa). Clin. Immunol. Immunopathol.; 4: No. 2, 286-290(Jul 1975).

Circulating lymphocytes obtained from normal individuals are capable of inducing cytotoxic death of ^{51}Cr-labeled rabbit spleen target cells in culture. An incubation time of 16 to 24 hr was sufficient to permit optimal cytolysis of the target cells. The cytotoxic activity was a property of the living cells as neither sonicated nor irradiated human cells displayed cytotoxic activity. The data suggest that this culture system may provide a rapid indicator for the immunocompetence of circulating human lymphocytes, insofar as their ability to express cell-mediated immunity is concerned. (auth)

29629 TOTAL-BODY IRRADIATION AND HUMAN CHROMOSOMES. V. Additional Evidence of a Transferable Substance in the Plasma of Irradiated Persons to Induce Chromosomal Breakages. Goh, K. (Oak Ridge Associated Universities, TN). J. Med. (Westbury, N. Y.); 6: No. 1, 51-60(1975).

A substance (or substances) produced or activated by total-body irradiation in man and capable of affecting the chromosomes for an extended time has been postulated. Leukocytes from normal persons were cultured with autologous plasma, homologous plasma or serum from patients irradiated 10.5 years previously. Thirty (5.5 percent) chromosomal breaks were found in the 550 metaphases from the control cultures, 152 (13 percent) in the 1175 metaphases from the irradiated plasma cultures and 130 (12 percent) in the 1100 metaphases from the irradiated serum cultures. This finding confirms and extends our previous observation that plasma from total-body irradiated persons is capable of inducing chromosomal breakage in normal leukocytes even 10.5 years after the irradiation. (auth)

29630 CHEMICAL PROCESSES IN NEUTRON CAPTURE THERAPY. Brown, B. J. (Macquarie Univ., North Ryde, New South Wales). At. Energy Aust.; 18: No. 1, 20-29(Jan 1975).

Research into the radiation chemical effects of neutron capture therapy is described. In the use of neutron capture therapy for the treatment of brain tumors, compounds containing an activatable nuclide are selectively concentrated within tumor tissue and irradiated with neutrons. Target compounds for use in therapy must accumulate selectively in high concentrations in the tumor and must be non toxic to the patient. The most suitable of these are the boron hydrides. Radiation dosages resulting from neutron capture in normal tissue constituents are tabulated. As part of the program to study the radiation-induced chemical processes undergone by boron target compounds, the radiolytic degradation of boron hydride and phenyl boric acid systems was investigated. No direct dependence between the yield of the transient radiolytic species and the concentration of the B-compound was observed.

29631 DATA PROCESSING SYSTEM FOR NUCLEAR MEDICINE. Saito, K.; Fujiki, Y.; Obayashi, I.; Asahina, K. (Tokyo Shibaura Electric Co. Ltd.). Toshiba Rev., Int. Ed.; No. 92, 36-40(1974).

A data processing system for nuclear medicine forms a scintigram in the magnetic core memories with γ camera data which is acquired on-line with high speed and efficiency. It eliminates quantum noise contained in the scintigram and corrects uniformity in it. In addition, the system prepares time series histograms from an original data group. (auth)

29632 CHANGES IN LYMPHOGRAMS AFTER RADIOTHERAPY AND CHEMOTHERAPY. Todorova, L. (Medical Inst., Sofia). Med. Radiol.; 20: No. 8, 66-69(Aug 1975). (In Russian)

Analyses of lymphograms made before and after radiotherapy and chemotherapy showed that the lymphatic system is changed to a significant degree, but with great individual variations. These variations must be taken into account in the evaluation of lymphograms after therapy. It is necessary to consider the altered flow in those tumors, the reduced capacity of their lymphatic systems, and the possibility of opening a lympho-venous communication. (JSR)

29633 RADIATION CHANGES IN LYMPH PLEXUS IN X-RAY PICTURES. Tsyb, A. F.; Nestaiko, O. V. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 20: No. 8, 69-75(Aug 1975). (In Russian)

Fractionated x-ray and γ irradiation at total doses up to 2500 rad in the first year after irradiation do not cause visible changes on lymphograms of the lymphatic vessels or nodes and the regional lymph flow. At later times (1 to 10 years) after irradiation at a total dose of 1500 to 2500 rad slight changes appear: contraction of the lymph vessels, absence of a picture of the valves, decrease of the node dimensions, and relative acceleration of the lymph flow. These changes were observed in 42.5 to 55.5% of the cases. After radiation therapy at doses up to 8000 rad peripheral and central defects of the filling and accumulation in lymphatic nodes did not appear, from which was inferred basic differences of radiotherapy from metastatic injuries. Radiation changes observed in the first year after therapy at doses not exceeding 8000 rad do not appear to be symptoms of impairment of the lymph flow. At later period impairment of the barrier functions of the lymph nodes begins. (tr-auth)

29634 COMPARATIVE STUDIES OF EARLY RADIATION-INDUCED PULMONARY CHANGES FOLLOWING X-RAY THERAPY AND TELEGAMMATHERAPY WITH ^{60}Co OF MEDIASTINAL TUMORS. Malska-Waniewska, I.; Fajndt, S. (Pracowni Rentgenowskiej Osrodka Onkologicznego, Lodz, Poland). Probl. Proch. Mashinostr.; 39: No. 6, 691-696(1975). (In Polish)

On the basis of an analysis of over 400 radiograms comparative studies of radiological findings in radiation-induced pulmonary changes were carried out in a group of 70 patients receiving radiotherapy for mediastinal changes. One half of the patients received conventional roentgenotherapy, and another half ^{60}Co telegammatherapy. In both groups the radiological characteristic features of lesions were the same and they developed with nearly identical frequency – in over $^3/_4$ of patients in each group, and their intensity was similar. Differences were found, however, in the time of their appearance of radiograms — after telegammatherapy they could have been observed earlier, sometimes even during radiotherapy. This fact is important for correct interpretation of the condition of patients undergoing treatment.

29635 CONSEQUENCES OF DOSE RESPONSE CURVES FOR TUMOR CONTROL AND NORMAL TISSUE INJURY ON THE PRECISION NECESSARY IN PATIENT MANAGEMENT. Herring, D. F. Laryngoscope; 85: No. 7, 1112-1118(Jul 1975).

From centennial conference on laryngeal cancer; Toronto, Ontario, Can. (28 May 1974).

This paper is concerned with an analysis of the relationship between dose response curves, treatment precision, and treatment outcome. The approach that is taken is first to define the term "treatment precision" as it is used in this paper and then to compare the expected treatment outcomes for two treatment systems with different levels of precision. The treatment outcomes will be calculated using assumed dose response curves for tumor control and for severe normal tissue injury. This approach is admittedly theoretical and is not intended to provide any quantitative conclusions concerning the treatment of patients. The approach will, however, provide valuable insight into the relationship between treatment precision and outcome. (auth)

29636 ESTROGEN AND THE IRRADIATED VAGINA. Pitkin, R. M.; Buchsbaum, H. J.; Lenz, H. (Univ. of Iowa Hospitals, Iowa City). Obstet. Gynecol.; 46: No. 2, 243-245(Aug 1975).

The vaginal response of patients to estrogen therapy following radiotherapy for cervical carcinoma is discussed. The authors take exception to the statement of Abitbol and Davenport that irradiation destroys the possibility of a vaginal response to estrogen stimulation. (ERB)

29637 CARCINOMA OF THE CERVIX: A THIRD TREATMENT. Quigley, M. M.; Knab, D. R.; McMahon, E. B. (National Naval Medical Center, Bethesda, MD). Obstet. Gynecol.; 45: No. 6, 650-655(Jun 1975).

A selected group of 136 patients with Stage I squamous cell carcinoma of the cervix was treated in six naval hospitals during the period 1957–1965 using a three-stage combined radiation therapy and surgery protocol. Treatment consisted of two radium applications to the cervix, followed in 6 weeks by extraperitoneal lymphadenectomy. If the lymph nodes were tumor-negative, simple hysterectomy in 3 to 6 months completed the protocol. If the nodes were tumor-positive, a course of external pelvic irradiation was given with midline shielding. The incidence of positive nodes was 9.6 percent. Actuarial survival for all patients was 89.4 percent, comparable to the rate obtained by radical surgery or radiation alone. Postoperative and postradiation complications were minimal, with no urinary or bowel fistulas. There was no operative mortality. (auth)

29638 LEUKOPENIA AFTER POSTMASTECTOMY IRRADIATION. Lewis, C. L.; Paterson, E. (Rochester General Hospital, NY). J. Am. Med. Assoc.; 235: No. 7, 747-748(16 Feb 1976).

Significant peripheral white blood cell depression was noted in 75 percent of postmastectomy patients receiving chest wall and nodal irradiation and in 50 percent of patients receiving only peripheral nodal irradiation. Leukopenia was documented for as long as 36 months following therapy. With the current trend to earlier institution of chemotherapy, the routine use of postoperative irradiation must be reevaluated. (auth)

29639 RADIATION DOSE DISTRIBUTIONS AND THEIR OPTIMIZATION. Orr, S. (West of Scotland Health Boards, Glasgow). Laryngoscope; 85: No. 6, 1024-1028(Jun 1975).

From centennial conference on laryngeal cancer; Toronto, Ont., Canada (28 May 1974).

The current situation in the radiotherapy treatment of carcinoma of the larynx is discussed from a physicist's point of view and in the light of the results of one series of patients. The results suggest that the spatial distribution of dose obtainable with supervoltage irradiation for treatment of T_1 to T_4 No Mo cases is not far from the ideal, and that it is not difficult to prescribe an optimal distribution. A significant difference in the rate of local cure was found between those treated to a CRE value greater than 1,750 and those treated to less than 1,750. Methods are suggested of optimizing the dose distribution in time by increasing the effect on tumor cells without exceeding an acceptable tolerance dose to normal tissues. (auth)

29640 CANCER AS A RISK OF EXPOSURE TO MEDICINAL RADIATION. Oeser, H. (Freie Univ. Berlin (F. R. Germany). Klinik fuer Radiologie, Nuklearmedizin und Physikalische Therapie). Muench. Med. Wochenschr.; 117: No. 31, 1257-1263(Aug 1975). (In German)

Radiocancer arises in a tissue or organ damaged by radiation; the ionizing rays have caused somatic radiation damage but have not produced cancer. A higher risk of cancer as a sequel to constantly increasing exposure to medicinal radiation has not been demonstrated so far. The statements quoted in the paper are due in particular to faulty comparative evaluations in retrospective surveys and to inadmissible extrapolations of findings after the action of high radiation doses to expected effects with low doses. In addition to radiobiology and radiophysics, knowledge of oncology and clinical radiology must also be taken into account in future. (DE)

29641 RADIATION DOSES FROM PHOSPHATE FERTILIZERS. Umwelt (Inf. Bundesminist. Innern); 75: No. 41, 10-11(Jun 1975). (In German)

The activity concentrations determined of ^{226}Ra, ^{232}Th and ^{40}K in nCi/kg P_2O_5 for the five most important kinds of fertilizer as well as their percent share in the economy year 1973/74 in the FRG are compiled in a table. From these values, the consumption of 0.917 million tons P_2O_5 and from an average annual fertilizer coverage of 68.3 kg/ha, one can calculate a distribution of 32 Ci ^{226}Ra, 1 Ci ^{232}Th and 543 Ci ^{40}K over the total agriculturally used area, in other words, a deposit of 2.4 μCi ^{226}Ra, 0.07 μCi ^{232}Th and 40.5 μCi ^{40}K per ha. Taking a pessimistic view, an external radiation exposure of 0.11 mrad/a was calculated for gonads and bone marrow. If the total accumulation of ^{226}Ra (38% of the radiation exposure) from phosphate fertilizers from the ground during the last 80 years is assumed, then there is an exposure of 1.7 mrad/a for individual members of the population and 2.0 mrad/a for those occupied in agriculture. (DE)

29642 RESULTS OF SHORT-FOCAL X-RAY THERAPY OF CANCER OF THE LOWER LIP. Tishchenko, L. A.; Mishchuk, R. P. (Rovensk Regional Obncological Hospital, USSR). Med. Radiol.; 20: No. 11, 79-80(1975). (In Russian)

The results obtained in the short-focus x-ray therapy of lower lip cancer in 286 patients are reported. The side effects noticed were inflammations in the form of epithelites and epidermites in the irradiation field. The survival rate of the patients receiving x-radiation therapy was tabulated. (JSR)

29643 FUNCTIONAL STATE OF THE HEMOPOIETIC SYSTEM IN THE TREATMENT OF PROLIFERATED METASTASES OF CANCER OF THE THYROID GLAND WITH RADIOACTIVE IODINE. Sokolova, I. I.; Reznichenko, F. M.; Kiseleva, E. S.; Brin, M. L. (Moscow Scientific Research Oncological Inst.). Med. Radiol.; 20: No. 11, 80-82(1975). (In Russian)

The introduction of ^{131}I (dose activity from 50 to 100 mC) at intervals of 3 months during therapy of individual metastases of thyroid cancer caused a decrease of the lymphocyte concentration in the blood during the first week after each injection of the isotope. During therapy with ^{131}I neutropenia and lymphopenia developed, the severity of which depended on the total quantity of the isotope introduced. The development of neutropenia was associated with an increase of the activity of the alkaline phosphatase in the neutrophyls. At the center of the bone marrow after the first 2 to 3 injections there was a decrease of the total cellules. Within 42 months after the termination of the therapy no significant variation was observed in the condition of the hemopoietic system. (tr-auth)

29644 CLINICO-PHYSIOLOGICAL SHIFTS IN RADIATION AND RADIO WAVE OCCUPATIONAL EFFECT. Lysina, G. G. Med. Radiol.; 20: No. 11, 50-55(1975). (In Russian)

The article presents materials on the study of peculiarities of the organism reactions to the effect of ionizing and nonionizing radiation in occupational conditions. The observations were made over 523 persons, of this number 196 persons were subjected to the effect of ionizing radiation, 218 persons — of electromagnetic fields (UHF) and 109 persons presented the control group. The results of clinicophysiological and biochemical investigations made it possible to note a number of shifts in hemodynamics and indices of oxygenation which were characterized by the change of the activity of the regulating systems of the body ensuring constancy of the internal environment of the organism. Changes were observed in persons subjected to exceeding irradiation and power of electromagnetic waves (UHF). They were caused by reflex alterations, disorders of the function of the neuroendocrine apparatus and also immediate effect on the cellular membranes. (auth)

29645 TRANSFORMATION OF THE BRAGG CURVE INTO DEPTH DOSE DISTRIBUTION OF THE GIVEN FORM. Lomanov, M. F. Med. Radiol.; 20: No. 11, 64-69(1975). (In Russian)

The author proposes the method of the Bragg curve transformation of protons and other heavy charged particles into a depth dose distribution which satisfies the condition of radiation therapy. A simple graphical procedure has been developed; it makes it possible to arrange the distribution of particle paths in the beam or the profile of the comb-shape filter forming this distribution. For each point along the depth of the object the plotting was made by fission of the dose required for this depth into a dose corresponding to the initial beam of the Bragg curve. The article discusses the possibilities of compensation of inaccuracy of the method when testing the obtained fields. (auth)

29646 MOBILE IRRADIATION OF BRAIN TUMORS ON A BETATRON. Smirnov, R. V.; Ignat'eva, I. A. (Leningrad Scientific-Research Neurosurgical Inst.). Med. Radiol.; 20: No. 11, 3-9(Nov 1975). (In Russian)

The authors developed the method of mobile (segmental) irradiation of tumors of the brain by electrons (23 MeV) or photons (25 MeV). The therapeutic zone in irradiation by an electron beam is determined by a 70% isodose, in the treatment with photons — 90% isodose. The presence of the tumor at the depth of up to 7.5 cm was an indication to mobile irradiation with electrons; with photons — the presence of newgrowths in the tissues or sites located at a greater depth. Irradiation in a mobile regime promotes the increase of the therapeutic zone by approximately 1.5 times and decreases the gradient of the dose and radiation loading on the skin within this zone as compared to the use of these types of irradiation under static conditions. A total of 14 patients out of 15 with tumors of the brain who had undergone mobile irradiation demonstrated good immediate results. Local and general radiation reactions were marked insignificantly. (auth)

29647 MEDULLARY HEMOPOIESIS IN PATIENTS WITH LYMPHOGRANULOMATOSIS DURING THE PROCESS AND AT REMOTE PERIODS AFTER RADIATION THERAPY BY A RADICAL PROGRAM. Baisogolov, G. D.; Shishkin, I. P.; Pavlov, V. V. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 20: No. 11, 9-15(1975). (In Russian)

The authors studied the condition of medullary hemopoiesis of non-irradiated parts of the bone marrow in 68 primary patients with lymphogranulomatosis. In 40 patients the intact and irradiated parts of the hemopoietic tissue were investigated at remote

periods. It was shown that in non-irradiated parts of the bone marrow during the implementation of the radical program hyperplasia developed. In patients with intoxication symptoms normalization of the myelocaryocyte content occurred. At remote periods after the radical program hyperplasia of hemopoietic tissue remained. In cases when irradiation was restricted by supradiaphragmatic lymphatic zones, hemopoiesis indices were close to the norm. In 3 to 5 years in the irradiated parts of the bone marrow (absorbed dose being not less than 3500 rad) aplasia could still be seen. (auth)

29648 INSTRUMENTATION-DOSIMETRIC PREREQUISITES OF INTRACAVITARY γ THERAPY OF CORPUS UTERI CANCER BY SOURCES OF HIGH ACTIVITY. Kostromina, K. N.; Titova, V. A.; Rimman, A. F.; Komar, V. Ya. Med. Radiol.; 20: No. 11, 16-21(1975). (In Russian)

The author describes an original design of the metrastat applicator which ensures the subsequent remote introduction of high specific activity sources on the hose γ therapy apparation Agat-B. The article presents the dose distributions in different location of radioactive preparations in the frontal and sagittal planes. The analysis of dose distributions makes it possible to note the perspectives of the use of the method—remote controlled afterloading for treatment of patients with endometry cancer. (auth)

29649 INJURY OF THE LUNGS IN RADIATION AND COMBINED TREATMENT OF BRONCHOGENIC CANCER. Strashinin, A. I.; Rabinovich, R. M.; Dyatlova, N. N.; Gladinova, T. S.; Dianina, E. S. Med. Radiol.; 20: No. 11, 21-31(1975). (In Russian)

The authors consider clinical and roentgenological data concerning patients with pulmonary carcinoma who underwent radical radiation treatment (258 patients) and postoperative irradiation after pneumonectomy (32 patients) for finding out the influence of physical and biological factors on the development of radiation complications in the lungs. Dependence of the frequency of radiation injuries upon the cumulative focal dose, methods of irradiation, initial condition of the pulmonary tissue, and age of the patients were observed. Radiation injuries of the lungs were observed in 48.4 per cent of the cases after radical radiation therapy and in 40.6 per cent of the cases after postoperative irradiation. (auth)

29650 EXPERIENCE IN ORGANIZING RADIATION SANITARY CONTROL WITH THE USE OF K4 PUNCH CARDS. Treyger, S. I.; Piskunov, L. I.; Komarskii, V. Ya. Gig. Sanit.; No. 8, 90-91(1975). (In Russian)

Standard K4 punch cards were introduced into radiation safety control measures in 1969 which, on both sides, carry the capacity to provide and record the pertinent radiation information and personnel data for a given object. The punch cards are designed for five years of use; they are based on simple direct and 7-4-2-1 combination codes. The use of the punch cards has eliminated a considerable amount of paper work and rendered the entire operation of radiation safety control a more efficient process. (JPRS)

29651 TIME, DOSE, AND VOLUME FACTORS IN INTERSTITIAL RADIUM IMPLANTS OF CARCINOMA OF THE ORAL TONGUE. Fu, K. K.; Chan, E. K.; Phillips, T. L.; Ray, J. W. (Univ. of California, San Francisco). Radiology; 119: No. 1, 209-213(Apr 1976).

From 62nd scientific assembly and annual meeting; Chicago, IL, USA (14 Nov 1975).

In a retrospective computer dosimetry analysis of 58 patients with carcinoma of the oral tongue treated with interstitial radium implants alone or in combination with external irradiation, dose and volume appear to be the most important factors in both local control and the incidence of necrosis; in the dose rate change commonly used in clinical interstitial radiotherapy, dose rate has no significant effect. The optimal minimum tumor doses for local control vary with the size of the primary lesion: 6,000 rads for T_1 lesions and 6,500 rads for T_2 lesions treated with interstitial radium implants in combination with external irradiation. For lesions treated with implants plus external irradiation, greater local control was achieved when most of the dose was delivered through the interstitial implants. For a given volume, the incidence of necrosis was directly proportional to the degree of overdosage; for a given dose, the incidence of necrosis was directly proportional to the degree of overdosage; for a given dose, the incidence of necrosis was directly proportional to the volume receiving the dose. (auth)

29652 BRONCHOGENIC CARCINOMA FOLLOWING POST-MASTECTOMY IRRADIATION. Steinfeld, A. D.; Ross, W. M. (Tufts-New England Medical Center, Boston). Radiology; 119: No. 1, 215-216(Apr 1976).

From 62nd scientific assembly and annual meeting; Chicago, IL, USA (14 Nov 1975).

Prophylactic irradiation of the regional nodes following mastectomy for breast carcinoma is a widely accepted practice. It often induces apical pulmonary fibrosis. A case of bronchogenic carcinoma arising in this fibrotic area, and its relationship to such radiotherapy, is discussed. (auth)

29653 ASPERMIA AND RECOVERY OF SPERMATOGENESIS IN CANCER PATIENTS FOLLOWING INCIDENTAL GONADAL IRRADIATION DURING TREATMENT: A PROGRESS REPORT. Hahn, E. W.; Feingold, S. M.; Nisce, L. (Sloan-Kettering Inst., New York). Radiology; 119: No. 1, 223-225(Apr 1976).

From 62nd scientific assembly and annual meeting; Chicago, IL, USA (14 Nov 1975).

The 11 patients in this study who received incidental gonadal irradiation from clinical therapy all became aspermic within 8 to 34 weeks following treatment. The estimated gonadal dose was 118 to 228 rads. Five of these patients have shown recovery of spermatogenesis; 3 of these have reached fertilizable concentrations. Recovery of semen sperm was noted at 44 to 77 weeks following treatment. The other 2 patients, after 110 to 176 weeks, have sub-fertile concentrations of semen sperm. Five patients have not been followed for a sufficient length of time to permit recovery to be noted. (auth)

29654 BILATERAL CAROTID ANEURYSMS SECONDARY TO RADIATION THERAPY. Bole, P. V.; Hintz, G.; Chander, P.; Chan, Y. S.; Clauss, R. H. (New York Medical Coll., NY). Ann. Surg.; 181: No. 6, 888-892(Jun 1975).

A patient was seen with symptomatic, rapidly expanding aneurysms that developed in both carotid arteries 4 years after bilateral radiation to the neck, left combined mandibular resection, and radical neck dissection. The presenting symptoms were pain and transient ischemic attacks of cerebrovascular insufficiency. The aneurysms were treated uneventfully by resection and vein-graft replacement at 15-day intervals. Microscopy demonstrated typical radiation changes. Effects of radiation on arteries are reviewed. (auth)

29655 A MORE DETAILED ANALYSIS OF CHROMOSOMAL ABERRATIONS BY MEANS OF A NEW ASG BANDING TECHNIQUE. Kucerova, M. (Ceskoslovenska Akademie Ved, Prague. Ustav Experimentalni Biologie a Genetiky). In Vitro CSSR; 2: No. 2A, 37-42(1974). (In Czech).

From 5th annual meeting of the Cytogenetic Section of the Czechoslovak Biological Society of the Czechoslovak Academy of Sciences; Hradec Kralove, Czechoslovakia (20 Sep 1972). Available by Ceskoslovenska Biologicka Spolecnost pri CSAV, Hradec Kralove, Czechoslovakia.

29656 MULTIPLE FLUOROSCOPY OF THE CHEST: CARCINOGENICITY FOR THE FEMALE BREAST AND IMPLICATIONS FOR BREAST CANCER SCREENING PROGRAMS. Delarue, N. C. (Toronto Univ., Ontario (Canada). Dept. of Medicine); Gale, G.; Ronald, A. (Toronto Hospital, Ontario (Canada)). Can. Med. Assoc. J.; 112: No. 12, 1405-1410, 1413(21 Jun 1975).

Of 792 women who had had tuberculosis and were followed for a minimum of 20 years, 451 had had multiple fluoroscopy while supine; 341 had not had fluoroscopy. The first group received a total radiation dose to the breast averaging 17 rads (141.5 fluoroscopies); the incidence of breast cancer in this group was not increased. Had fluoroscopy been performed with the patient prone the total radiation dose would have averaged 308 rads. The difference is though to explain the increased incidence of breast cancer attributable to fluoroscopy given with the patient prone. Mid-breast exposure with mammography or xeroradiography varies between 3 and 6 rads. Repetitive screening would, therefore, appear safe provided total exposure did not exceed 20 rads. With this restriction there would appear to be no reason to curtail screening of women for breast cancer. (auth)

29657 INVESTIGATIONS ON CHANGES IN SERUM PROTEIN AND ELECTROLYTE PATTERNS IN PATIENTS WITH CERVICAL CARCINOMA DURING TREATMENT WITH IONIZING RADIATION. Haruppa, J.; Madajewicz, S.; Radom, S.; Swiatkowska, H.; Nickie-Psikuta, M. (Instytut Onkologii, Warsaw (Poland)). Nowotwory; 24: 17-21(1974). (In Polish).

Investigations were carried out to establish the levels of serum proteins and electrolytes in 155 cases of cervical carcinoma grade I, II, and III treated in the years 1969 to 1970 with ionizing radiation at the Institute of Oncology in Warsaw. The level of total protein was determined by the burette method of Wolfson, the protein fractions by the method of paper electrophoresis of Durram, the concentration of serum and potassium by the method of flame photometry using a Zeiss model III flame photometer, the chlorine level by the method of Schales–Schales. The investigations demonstrated that in patients with cervical carcinoma grade I,

II, and III treated with ionizing radiation the concentration of alpha$_1$ and alpha$_2$ globulins increases strikingly in all clinical grades while there is a general tendency for a decrease of the serum albumin concentration. An increasing tendency is observed also in beta globulins. (auth)

29658 ABOUT THE USE OF CHROMOSOME ANALYSIS AS INDICATOR OF RADIATION INJURIES. Todorov, S. (Meditsinska Akademiya, Sofia (Bulgaria). Tsentyr po Zarazni i Parazitni Bolesti). Letopisi Khig. Epidemiol. Inst.; 8: No. 43, 60-71(1974). (In Bulgarian).

Advantages of the use of peripheral blood lymphocyte cultures for the purpose of cytogenetic analysis is emphasized with concern to biological dosimetry and its weaknesses. The significance of the etalone curves made out on the yield of dicentrics after various radiation doses is underlined. Attention is drawn to possibilities which this analysis suggests for the different kinds of aberrations, especially multi-hit aberrations (without dicentrics), realized one-hit and two-hit lesions of the cell and frequency of aberrant cells in percents. The yield of dicentrics (Y) in relation to dose in rad (D) after X- and gamma-irradiation is best fitted mathematically by the equation $Y \simeq bD^n$. The values of coefficients of regression "b" and "n" defined in various cytogenetic laboratories show considerable differences because of variabilities in time for cultivating, temperature during irradiation, dose-rate etc., as well as the different age and other genetically defined features. Cytogenetic analysis for the purposes of biological dosimetry is used in accidents especially when the irradiated persons were not supplied with dosimetrical apparatuses and in accidents of radiation burden of persons working with sources of ionizing radiation but not carrying film dosimeters. The necessity for such etalone curves made out for radiation with different characteristics is underline.

29659 THE SEARCH FOR NEW RADIOPROTECTIVE AGENTS. Pt. 28. Synthesis of Sulphenamide Derivatives of 2-Aminobenzothiazole, 3-Methylthiophenothiazine and Phenothiazine. Tulecki, J.; Osinska, Z.; Nacewicz-Anjedani, H. (Akademia Medyczna, Poznan (Poland)). Acta Pol. Pharm.; 31: No. 2, 169-173(1974). (In Polish).

For English translation see the journal Pol. Pharm. Trans.

There are reported syntheses of 2-(2-nitrobenzenesulphenamido)-benzothiazole (I), 2-(4'-nitrobenzenesulphenamido)-benzothiazole (II), 10-(4'-nitrophenylthio)-3-methylthiophenothiazine (III), 10-(3'-nitrophenylthio)-3-methylthiophenothiazine (IV) and 10-(2', 4'-dinitrophenylthio)-phenothiazine (V), not described in the available literature. (auth)

29660 ANALYSIS OF THE AVERAGE ANNUAL NATURAL RADIATION EXPOSURE OF THE POPULATION IN THE CSR. Spurny, Z.; Kovarzh, Z.; Kochi, I.; Shultsova, Ya. (Ceskoslovenska Akademie Ved, Prague. Radiologicka Dozimetrie Ustavu Jaderneho Vyzkumu). Kernenergie; 18: No. 8, 260-262(1975). (In Russian).

The results of evaluating the average annual gonad dose of the population of the CSR due to external natural radiation as well as an analysis of the individual components forming the resulting data are given.

29661 CHARACTER OF WORK WITH RADIOACTIVE SUBSTANCES AND WORK SAFETY. Tolgyessy, J. pp 396-401 of Radiotracer Method in Practical Work. Akerman, K. Bratislava; ALFA (Dec 1972). (In Slovak)

Addendum to the translation of "Techniczne zastosowanie metody atomow znaczonych," Warsaw, 1970.

Problems of safety of work with radioactive substances are discussed.

29662 RECOMMENDATIONS ON STANDARDIZATION FOR MICTIONCYSTOURETHROGRAPHY IN INFANCY. Rupprecht, E. (Medizinische Akademie, Dresden (German Democratic Republic). Kinderklinik; Gesellschaft fuer Medizinische Radiologie und Gesellschaft fuer Paediatrie der DDR (German Democratic Republic). Arbeitsgemeinschaft Kinderradiologie und Kindernephrologie). Dtsch. Gesundheitswes.; 30: No. 8, 360-362(Feb 1975). (In German).

Recommendations on standardization for mictioncystourethrography in infancy have been worked out by the teams on radiology and nephrology in children of the Societies for Medical Radiology and Pediatrics in the GDR. The indications for this examination and the methods with special consideration of radiological protection are described. The recommendations aim at a uniform proceeding in the different X-ray diagnostic institutions. (auth)

29663 IONIZING RADIATION PROTECTION DURING THE WORK. Troisi, F. M. Riv. Infort. Mal. Prof.; 61: No. 4-5, 607-663(Jul 1974). (In Italian).

The problems concerning the ionizing radiation protection during the work, in different fields as industry, agriculture, medicine, are examined in detail. The possible radiation sources are listed and the protection equipments to be used and the safety standard are presented. Characteristic data are also reported. (INIS)

29664 RADIATION PROTECTION IN OPERATING ROOMS. Sewcz, H. G.; Frahm, W. (Rostock Univ. (German Democratic Republic). Radiologische Klinik); Koenig, W.; Menzel, B.; Taschner, P. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 99: No. 52, 1643-1653(Dec 1974). (In German).

To characterize the radiation situation in operating rooms the following area monitoring checks were performed: Measurements in the useful beam (image intensifier, with and without attenuation by a phantom), strap radiation measurements at various distances from the source and the phantom, respectively, and measurements representing typical radiographic conditions in operating rooms and at the patient's bed. (INIS)

29665 RADIOACTIVE SUBSTANCES. Radiation Protection Regulations, Pt. 3. Zakovsky, J. (Bundesministerium fuer Gesundheit und Umweltschutz, Vienna (Austria)). pp 37-39 of Physical Radiation Protection Control in Accordance with the Austrian Radiation Protection Law and Regulations. Annual Meeting 1972 of the Austrian Association for Radiation Protection, Vienna (Austria), 22 June 1972. Boese, A.; Sorantin, H. (eds.). Vienna; OEVS (1973). (In German).

From annual meeting 1972 of the Austrian Association for Radiation Protection; Vienna, Austria (22 Jun 1972). Available from Oesterreichischer Verband fuer Strahlenschutz, Lenaugasse 10, A-1082 Vienna (Austria).

In this summary of the third part of the radiation protection regulations the prescriptions for operation, storage and transport of radioactive substances and those concerning contamination, decontamination and the control of the environment are described. Details for enclosed and open radioactive materials are given. (INIS)

29666 RADIATION SOURCES, RADIATION PROTECTION REGULATIONS, PT. 2. Radiation Protection Regulations, Pt. 2. Zakovsky, J. (Bundesministerium fuer Gesundheit und Umweltschutz, Vienna (Austria)). pp 33-35 of Physical Radiation Protection Control in Accordance with the Austrian Radiation Protection Law and Regulations. Annual Meeting 1972 of the Austrian Association for Radiation Protection, Vienna (Austria), 22 June 1972. Boese, A.; Sorantin, H. (eds.). Vienna; OEVS (1973). (In German).

From annual meeting 1972 of the Austrian Association for Radiation Protection; Vienna, Austria (22 Jun 1972). Available from Oesterreichischer Verband fuer Strahlenschutz, Lenaugasse 10, A-1082 Vienna (Austria).

This summary of the second part of the radiation protection regulations is concerned with the performance and operating conditions of radiation sources (except these with natural radioactivity). The requirements set on x-ray sources, electron accelerators and the rooms where they are installed are described.

29667 EXIT DOSE MEASUREMENTS IN ASSESSMENT OF EFFECTIVE BODY THICKNESS. Agrawal, M. S.; Pant, G. C.; Srinivasan, S.; Sood, P. C. (Banaras Hindu Univ., India). pp 429-438 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

In the absence of any known air cavity or high density media in the treatment field, it is customary to consider the irradiated volume to be made up of unit density soft tissue and the doses are calculated on that basis. The high recurrence rate of about 20 to 25% was observed in cases of carcinoma of cervix following ^{60}Co therapy made us wonder whether the pelvic region really behaves like a unit density material as is thought of for dose calculations. The exit dose measurements made with thermoluminescent dosemeters in 50 such cases revealed that the effective body thickness is more in the majority of the cases and the dose received is about 7% lower than planned dose on the basis of measured body thickness. (auth)

29668 PROBLEMS OF INTESTINAL ABSORPTION FOLLOWING IRRADIATION. Knopp, W. Leipzig, Germany; Karl-Marx-Univ. (1972). 178p. (In German). INIS.

Thesis.

The following topics are discussed appropriate substances, their passage through the human organism from intake to excretion, factors influencing the intestinal absorption and their practical importance. The tests with 18 cancer patients were aimed at determining the influence of radiation-induced morphological and functional changes on the intestinal absorption of wheat starch. Such an influence could not be detected. (INIS)

29669 OCCUPATIONAL RADIATION EXPOSURE CONTROL IN MIXED-OXIDE FUEL FABRICATION PLANTS. Willis, C. A. (Atomic Energy Commission, Washington, DC). Conf. Remote Syst. Technol., Proc.; 22: 65(1974).

From 22nd conference on remote systems technology; Washington, DC, USA (Oct 1974).

The general elements essential to an acceptable approach to keeping occupational radiation exposure in mixed-oxide fuel fabrication plants as low as practical are identified. (LCL)

29670 EXTERNAL RADIATION EXPOSURE AND RADIOTOXICITY CONSIDERATIONS IN PLUTONIUM/URANIUM MIXED-OXIDE FUEL FABRICATION. Williams, R. A.; Crosby, E. H. (Nuclear Materials and Equipment Corp., Apollo, PA). Conf. Remote Syst. Technol., Proc.; 22: 66-68(1974).

From 22nd conference on remote systems technology; Washington, DC, USA (Oct 1974).

Nuclear-reactor-produced plutonium emits significant electromagnetic and neutron radiations. In addition, because of its high specific alpha activity and its tendency to deposit in the lung and the soft tissues of the bone, plutonium presents a significant radiotoxicity hazard. Shielding, containment, and dosimetry techniques practiced at the Nuclear Materials and Equipment Corporation (NUMEC) have resulted in exemplary annual safety report statistics relevant to non-remote-handling plutonium operations. Whereas a few employees exceeded the NUMEC external exposure action level, no employee exceeded the Regulatory maximum permissible external exposure. In addition, a few employees were observed to have a lung burden in excess of the minimum sensitivity of an in vivo counting system, and one employee was observed by in vivo counting to have a lung burden in excess of the maximum permissible for a brief period. No employee was observed to have a body burden as indicated by a positive quarterly urinalysis result. Further, there were no serious incidents at the facility requiring immediate Regulatory notification, and there were no moderate incidents at the facility requiring 24-h Regulatory notification. However, there were a few reportable incidents at the facility requiring 30-day Regulatory notification, and there were a few minor incidents at the facility requiring the preparation of a NUMEC Incident Report. Details of this safety record are presented along with the health physics techniques that have contributed to the results. (auth)

29671 EFFECT OF RADIATION THERAPY ON LYMPHOCYTE SUBPOPULATIONS IN CANCER PATIENTS. Raben, M.; Walach, N.; Galili, U.; Schlesinger, M. (Hebrew Univ., Jerusalem). Cancer; 37: No. 3, 1417-1421(Mar 1976).

The proportion of T and B lymphocytes in the peripheral blood was determined in patients with either mammary cancer or with various pelvic malignancies. In cancer patients studied prior to irradiation the level of cells forming either E-rosettes or EAC'-rosettes was similar to that found among healthy controls. Radiation therapy resulted in a striking lymphopenia. The level of cells with T-cell markers was diminished to a greater extent than the level of cells with B-cell markers. The relative proportion of T-cells forming high affinity E-rosettes was not reduced following radiation, so that it can be concluded that radiation affects predominantly the subpopulation of T-cells which do not form high affinity E-rosettes. Irradiation of the pelvic area resulted in a more rapid reduction of the level of T lymphocytes than irradiation of the mediastinum, although the final relative proportions of the cells were similar in both groups of patients. The results of the present study suggest that the reduction of the level of T lymphocytes following irradiation results from its effect on the lymphocytes in the major blood vessels, and that radiation of the thymus is not a prerequisite for this phenomenon.

29672 DESTRUCTIVE LESIONS OF THE NOSE. Damiani, R.; Mariotti, A. (Univ., Bologna). Minerva Chir.; 26: 1429-1435 (31 Dec 1971). (In Italian)

The plastic surgery reconstruction of the nose with destructive lesions caused by tumors, radiodermitis, or radionecrosis is briefly described. The special problems of radiodermitis and radionecrosis are indicated. The technique recommended in any case is the one that is the simplest possible leading to a rapid healing and satisfactory results. (JSR)

29673 RADIOTHERAPY IN THE TREATMENT OF BRONCHIAL EPITHELIOMAS. Pourquier, H. (Hopital Saint-Eloi, Montpellier, France). Poumon Coeur; 29: No. 6, 737-738(1973). (In French)

The indications and counter-indications for radiotherapy are briefly summarized. The irradiation techniques used are described in slightly more detail. (JSR)

29674 EVALUATION OF POPULATION EXPOSURE TO KRYPTON-85 RADIATION. Cejnar, F.; Wilhelmova, L. (Czechoslovak Academy of Sciences, Prague). Jad. Energ.; 20: No. 1, 7-12(Jan 1974). (In Czech)

Literature data are surveyed on the release of ^{85}Kr to the environment, and the trends of the accumulation of the radioisotope in the atmosphere up to the year 2000 are evaluated. Discussed are the relationships between the radioisotope sources and the doses to the human organism. The dose rates of β and γ radiations to individuals of the world population and of the critical population group are calculated. They are shown to be well under the permissible limits throughout the entire period till the year 2000. It is pointed out that considering the characteristics of ^{85}Kr radiation effects, the current recommendations as to the value of the maximum permissible concentration are highly overestimated. The limiting value of the MPC may have been as much as 6 times higher had the β radiation dose to the surface of the human body been referred to as a criterion, or 10 times higher had the similar dose to the most sensitive layer of the human skin been applied as a standard. (Nuclear Sci. Abstr. Czech.)

29675 NEW SOVIET REGULATION ON RADIATION PROTECTION OF PATIENTS IN NUCLEAR MEDICINE. Husak, V. Jad. Energ.; 20: No. 1, 27(Jan 1974). (In Czech)

Information is presented on the new Soviet regulation related to the radiation protection of patients in the diagnostic application of radioactive substances. The new regulation takes into consideration the risk of the possible early radiation effects, of delayed radiation effects, of teratogenic and of genetic effects. The maximum permissible doses to the critical organs of the patients are distinguished by the character of the diagnostic procedure, by the sex and age of the patient. (Nuclear Sci. Abstr. Czech.)

29676 CONCEPT OF EFFECTIVE DENSITY OF PHANTOM MATERIALS FOR ELECTRON DOSIMETRY AND A SIMPLE METHOD OF THEIR MEASUREMENT. Geske, G. (Univ., Jena, Ger.). Radiobiol. Radiother.; 16: No. 6, 671-676(1975). (In German)

The effective densities of materials used for phantoms may be considered, with some restrictions, as a criterion for the equivalence of the materials related on their interactions with fast electrons. After a survey about the main interactions and the materials-dependent functions that may be deduced from them the connection between these functions and the effective density is treated. The possible use of this quantity as a measure of material equivalence is discussed. Finally a simple method is given to measure the effective density of a material intended to use for phantoms. (auth)

29677 INFLUENCE OF NATIVE HOLLOW SPACES OF THE HUMAN BODY ON DOSE DISTRIBUTION OF ELECTRONS WITH AN ENERGY OF 5 TO 20 MeV. Skoropad, Yu. D. (Research Inst. of Medical Radiology, Obninsk, USSR). Radiobiol. Radiother.; 16: No. 6, 677-686(1975). (In German)

The methods of calculation based on the principle of equivalent absorbing thicknesses (ÄAD) do not fully consider the influence of shape and size of air-spaces on high-energy electron dose distribution thus rendering difficult planning and judgement of the effectivity of electron therapy for tumours in the mandibular and cervical region. With a dose error width of ±5% the regularities in dose distribution of electron energies of 5 to 20 mev behind hollow spaces are experimentally determined by the model of a cylindrical hollow space the size and depth of which being given in parts of the extrapolated electron range (R). The arrangement of dose fields behind the hollow spaces was made with an error of ±16% by transforming the dose fields measured in homogeneous medium. This transformation is based on the determination of the cone of immediate "visibility" of the wall of the hollow space by the film; the dose curve of depth distribution behind the hollow space. (auth)

29678 ISODOSE DETERMINATION FOR THE VAGINAL CYLINDER IN ^{60}Co CONTACT THERAPY. Tautz, M.; Ertl, S. (Staeditische Klinik, Berlin). Radiobiol. Radiother.; 16: No. 6, 641-654(1975). (In German)

In this paper isodoses of different activities in vaginal cylinders are represented and discussed. When ^{60}Co sources are used the geometrical dose distribution can be found to be more favourable than with an x-ray contact therapy. It is shown that changes of the relative depth dose occur only then when more than one segment of the vaginal cylinder is filled. Figures are selected in this way that the most important and most frequent cases of vaginal carcinoma can be discussed. The computer programme mentioned permits a wide variation with respect to geometrical and radiator specific properties. (auth)

29679 EXAMINATIONS ON THE SUITABILITY OF LiF PROBES FOR THE DETERMINATION OF THE GONAD DOSE IN RADIOLOGICAL MEASURES. Degner, W.; Schmidt, E. L. (Humboldt

Univ., Berlin). Radiobiol. Radiother.; 16: No. 6, 655-662(1975). (In German)

For the determination of successive partial dose values LiF probes are increasingly used. In order to be able to measure the gonad dose to a large patient material in radiological measures it is necessary to know the dose characteristic, dose dependence of sensitivity for single exposure and for the summation of variable partial doses. Furthermore examinations on the dependence of sensitivity on the generating voltage and on the directional dependence of sensitivity in measurements of the surface dose were carried out. Decisive for the usability of LiF probes for the given tasks is the extent of the also determined directional dependence in the field of scattered radiation. Based on the measurements performed it can be shown that with the knowledge and consideration of essential parameters LiF probes also for low dose values and tube voltages being used in the diagnostic field yield results which lie within a permissible limit of error. (auth)

29680 RADIATION BIOLOGY OF THE THYROID. Malone, J. F. (Coll. of Tech., Dublin). Curr. Top. Radiat. Res. Q.; 10: No. 4, 263-373(Oct 1975).

The structure and function of the thyroid gland are described. A detailed analysis of population kinetics in the gland suggests a method of measuring cell survival after irradiation that has many features in common with methods used in other mammalian cell systems. This method is used to obtain survival curves for thyroid cells after irradiation. The effects on survival of splitting the radiation dose into two or multiple fractions, radiation type, and radioprotective agents are also examined. In the light of these data the tolerance of thyroid tissue to radiation exposure under various conditions is discussed. The dosimetry and biological effects of ^{125}I and ^{131}I are described in detail, and compared with X-rays. Radioiodine treatment of thyrotoxicosis is presented in relation to the known biological effects of the isotopes on the gland. Carcinogenic action of ionizing radiations in the thyroid is reviewed with particular reference to the clinical consequences of observations in this field. (NL)

29681 DEPTH-DOSE MEASUREMENTS OF d-T NEUTRONS FOR RADIOTHERAPY APPLICATIONS. Broerse, J. J. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands); Broers-Challiss, J. E.; Mijnheer, B. J. pp 11-13 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29682 PROPOSED CLASSIFICATION OF THE COMBINED INJURIES DUE TO MEANS FOR MASSIVE LOSSES. Panajotov, N. (Meditsinska Akademiya, Sofia (Bulgaria). Katedra po Mediko-Sanitarna Zashtita). Suvrem. Med.; 25: No. 6, 3-7(1974). (In Bulgarian)

On the basis of experience and literary sources, more precise definitions in terminology of combined injuries are made and new elements in its classification are contributed. Proposed is a wider classification for the combined radiation injuries. It gives an opportunity for an expeditive grading of the injured persons exposed to atomic bomb radiation. The quick evacuation and treatment of the different groups of affected persons is also facilitated. Attention is drawn to the fact that the frequency of different kinds of combined injuries will to a great extent depend on the way the atomic bomb is exploded. Some peculiarities in clinical characteristics of the different kinds of injuries are pointed out.

29683 5 MREM GUIDE PROPOSED FOR "AS LOW AS PRACTICABLE": VERY HARD TO ELEC. INDUSTRY. At. Jap.; 18: No. 11, 15-27(Nov 1974).

Two reports were released in Oct. '74, by the Environmental Safety Special Committee of the AEC, one by the Section Committee on Coordination and the other by the Section Committee on Environmental Radioactivity. Under the control of the Coordination Committee of ESSC, five subcommittees were set up to look into particular problems; (1) environmental radiation, (2) nuclear safety, (3) effects of low level radiation, (4) disposal of solid radioactive wastes, and (5) liquid effluent. The report by the Coordination Committee contains the suggestions made for the improvement of nuclear regulatory system and the ways of winning the understanding and cooperation of the people on nuclear development. In order to strengthen the structure of the system for reactor safety examination, the Committee has made the proposals which were the outcome of careful consideration of the policy capable of practical application. Another recommendation was on the low as practicable idea. The report by Section Committee on Environmental Radioactivity contains recommendation to set the numerical guide for planning design objectives and limiting the conditions for operation to meet the criterion set, viz. "as low as practicable", applied to radioactive substances in the effluent from light-water-cooled nuclear power reactors. The values proposed are 5 millirems to whole body, and 15 millirems of I^{131} to thyroid, which indicate dose objectives around the sites of LWRs for one year exposure.

29684 INTERPLAY OF RADIOCURABILITY AND TOLERANCE IN THE IRRADIATION OF HUMAN CANCERS. Fletcher, G. H.; Shukovsky, L. J. (Anderson (M. D.) Hospital and Tumor Inst, Houston, Tex. (USA)). J. Radiol., Electrol., Med. Nucl.; 56: No. 5, 383-400(May 1975).

Certain concepts are basic to the understanding of a practice of radiotherapy adapted to individual clinical situations: in planning for a specific clinical situation, the term cancerocidal or lethal dose must be replaced by the percentage of control expected from a time-dose-tumor-volume relationship. Elimination of the concept of homogeneity of dose in the irradiated volume. Doses in the same patient should vary with the size of the masses in the various treated areas. Elective irradiation of the lymphatics requires only 5,000 rads but gross masses of various sizes require appropriately higher doses. Elimination of the concept of either irradiation or surgery. One must think in most situations of combined treatment both for the primary lesion and regional metastases, with varying degrees of radicalism for the surgical procedures and the irradiation. Conservatism in both disciplines is to be preferred. If irradiation has no place as the sole treatment for a disease, for example soft tissue sarcomas or parotid tumors, it does not mean that it has no place in the management of the disease. In all of these approaches, the concept of tolerance must be kept flexible. Tolerance is not a fixed parameter but one which has to be gauged against the severity of the disease and the functional result one wishes to obtain. (FR)

29685 INTERSTITIAL CURIETHERAPY WITH IRIDIUM 192 APPLIED TO SMALL CANCERS OF THE RECTUM. Papillon, J.; Montbarbon, J. F.; Gerard, J. P. (Centre de Lutte contre le Cancer Leon-Berard, 69- Lyon (France)). J. Radiol., Electrol., Med. Nucl.; 56: No. 5, 439-442(May 1975). (In French).

Intracavity irradiation aimed at curing cancers of the rectum mainly calls on contact radiotherapy but also on interstitial curietherapy. Iridium curietherapy has replaced radium-therapy owing to the better homogeneousness of its action and precise method of assay. It uses a 2 pronged fork containing 2 iridium wires which can be very simply placed in position. It is applied on the one hand to the base of the ulcerated tumour, after abrasion by contactotherapy and on the other hand as a method of prophylactic irradiation after exeresis of a malignant or degenerated polyp where the scar is badly adapted to contactotherapy. (FR)

29686 EXCLUSIVE RADIOTHERAPY (TELECOBALT THERAPY-RADIUM THERAPY) IN EPITHELIOMA OF THE CERVIX OF THE UTERUS. Pourquier, H. (Hopital Saint-Eloi, 34- Montpellier (France)). J. Radiol., Electrol., Med. Nucl.; 56: No. 5, 411-417(May 1975). (In French).

The results of 420 cases of epithelioma of the cervix of the uterus treated between 1959 and 1969, using exclusively physical agents such as cobalt therapy and radium therapy are presented. 399 cases are analyzed. 9 patients could not be traced and 12 died intercurrently. The 1969 U.I.C.C. classification was adopted. External irradiation always preceded radium therapy and its importance varied according to the stage: however, doses of 2,000 to 5,000 rads were used at the rate of 1,000 rads weekly for two to five weeks; this was followed by classical radium therapy (Paris method) with colpostat and uterine sound. The number of mgh was consequently reduced and the dose administered was inversely proportional to that of the external irradiation. On the whole, tolerance was good in this type of treatment. Complications were mainly limited to a few minor intestinal disorders; in belated sequelae, these disorders were not more than those usually noted. (FR)

29687 DOSE OF TISSUE TOLERANCE, DOSE OF TUMOUR STERILISATION IN CONTINUOUS AND DISCONTINUOUS IRRADIATION. Swyngedauw, J. (Clinique de la Louviere, 59- Lille (France)). J. Radiol., Electrol., Med. Nucl.; 56: No. 5, 369-381(May 1975). (In French).

In the radiotherapy of cancer, two conditions are necessary: sterilisation of the tumour; safeguard of surrounding tissues. In discontinuous irradiation, sterilisation depends on the administration of a certain tumour-dose within a suitable period or number of sessions. Orton and Ellis have published tables which permit to obtain, without calculation, a time-dose fraction factor T. D. F. which represents what one might call an index of saturation of the supporting tissue by means of a series of double entry tables corresponding each to a frequency of 1, 2, 3, 4, 5 sessions per week. Each table provides the T. D. F. factor in relation to the number of sessions and the elementary dose. The conditions of obtention of continuous irradiation do not permit to separate the doses of sterilisation and tolerance, as is the

case with discontinuous irradiation but, generally speaking, both in continuous and discontinuous administration the shorter the period of treatment the more the sterilising dose exceeds the tolerance dose, whereas with very small tumours, one may obtain tumour sterilisation within the limits of tolerance of the supporting tissues. For very large or radio-resistant tumours, one may have to, in order to obtain sterilisation, exceed more or less the perfect tolerance defined by T.D.F. 100 or its equivalent using Ellis equation. The latter is moreover, only an approximation: the effective tolerance, if one takes into consideration late fibrosis, is very much less than that defined by T. D. F. 100, in particular for high partial dose irradiations. The absolute necessity of taking into consideration the time factor as defined by Ellis relationship is underlined. (FR)

29688 IN VIVO DOSIMETRY FOR TREATMENT OF CANCER OF THE CERVIX. Benary, V. (Tel Aviv Univ., Israel); Friedland, S. S.; Majteles, M.; Warner, A. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 655-656(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The treatment of uterine cervical neoplasms with intra-cavitary applications of radioisotopes has been practiced widely for the past half century. An overwhelming conclusion has emerged: if performed accurately these treatments may be very worthwhile, otherwise acute complications ensue. It has been observed that often the intracavitary applications are the source of excessive irradiation due to inaccurate placement of sources and improper choice of source activities. The ensuing complications are most often cystitis of the bladder, proctitis of the rectum and or fistulae in the vagina, bladder and rectum. Furthermore, if inaccurately performed, intracavitary applications will not result in irradiation of the tumor to the required dose. For all these reasons, it is very important to verify the dose distribution within the patient treated with intracavitary applications of radioactive sources. The best proven method of such verification is through measurement of dose rates along the rectum and if possible the bladder.

29689 RADIOLOGICAL HEALTH SIGNIFICANCE OF CARDIOVASCULAR SPECIAL PROCEDURES. Properzio, W. S. Gainesville, FL; Univ. of Florida (1975). 313p. University Microfilms Order No. 76-4270.

Thesis (Ph. D.).

Published information has indicated that radiation exposure to patients and personnel involved with cardiac catheterization procedures is high. A study of the radiation exposure to both groups has been carried out. Variations in exposure levels related to factors such as patient classification, equipment configuration and operational procedures have been investigated. Based on the findings in this study, a comprehensive set of radiological health recommendations are given. Equipment modifications that would allow acquisition of the necessary diagnostic information with less exposure are also proposed. An analysis of the personnel monitoring records from ten medical facilities involved with the conduct of cardiac catheterization special procedures showed exposure levels significantly higher than those reported for diagnostic x-ray workers in general. Exposures at various body sites on the physician and technologists involved with catheterization examinations of pediatric and adult patients were also investigated. The unshielded head and neck regions were seen to receive the highest exposures when compared to the established radiation protection guides for various parts of the body. (Diss. Abstr. Int., B)

29690 THERAPEUTIC RADIOLOGY: THE MODALITIES AND THEIR EFFECTS ON ORAL TISSUES. Rubin, R. L.; Doku, H. C. (Tufts Univ., Boston). J. Am. Dent. Assoc.; 92: No. 4, 731-739 (Apr 1971).

In recent years, therapeutic radiology has been used extensively in the management of head and neck malignancies. An increasing number of the population who have been exposed to such therapy are being seen by the dentist for dental treatment. It is recognized that radiation therapy may cause temporary and permanent alterations in tissue. A discussion of the various therapeutic modalities and their side effects on the oral tissues has been presented to aid the dental practitioner in understanding the problems and care of such patients. (auth)

Vertebrates

29691 (INIS-mf-1889, pp 51-66) X-RAY INDUCED CATARACT IN RABBIT LENS. Chapter 5. Liem-Thé, K. N.; Hoenders, H. J.; Stols, A. L. H.; Jap, P. H. K. 17 Apr 1975.

This chapter has been submitted for publication in Exp. Eye Res.; 9 figs., 28 refs.

In the structural proteins of the rabbit eye lens after x-irradiation. (Katholieke Universiteit Nijmegen (Netherlands)).

Experimental cataracts were formed by x irradiation in one eye of two-month-old rabbits with 1800 rad. In the cataractous lens, high-molecular weight (HM) crystallin is already found in great amounts in the lens cortex, whereas in the unirradiated lens, this is true only for the nucleus. In the cataractous cortex and nucleus, α and β crystallin polypeptide chains are found; in the normal lens cortex, relatively simple polypeptide chain components exist. Electron microscopic studies of HM crystallin from the cataractous lens cortex and nucleus revealed a wide size distribution of irregularly shaped giant aggregates which were also found in the normal nucleus. Relatively small aggregates were seen in the HM crystallin of the normal cortex. The cataractous lens showed pathological changes, as demonstrated by a distinct granular content of the fibres. Indications for an interpretation of x-ray induced cataracts in terms of an accelerated aging process are discussed. (INIS)

29692 (INIS-mf-1889, pp 67-82) CHANGES IN THE PROPORTION AND COMPOSITION OF STRUCTURAL PROTEINS DURING THE DEVELOPMENT OF X-RAY CATARACT IN RABBIT LENS. Chapter 6. Liem-The, K. N. 17 Apr 1975.

This chapter has been submitted for publication in Exp. Eye Res.; 3 figs., 5 tables, 41 refs.

In the structural proteins of the rabbit eye lens after x-irradiation. (Katholieke Universiteit Nijmegen (Netherlands)).

One eye lens of rabbits was x-irradiated in order to induce a cataract. One, two and three months after exposure, the irradiated lenses and their controls were studied. Between two and three months after exposure, the total protein content diminished, whereas water-insoluble protein increased. It was found that this loss of protein is reflected by the disappearance of β and γ crystallin; a rough estimation revealed a loss of 55% and 65% respectively. In regard to the amount of the urea-insoluble fraction, no essential change was observed, whereas that of the urea-soluble fraction was found to have increased dramatically. The water-soluble fraction was fractionated into five to seven fractions by column chromatography. High-molecular weight crystallin content increased progressively with the maturing of the cataract. This held true especially for HM crystallin in the cortex. Moreover, a decrease was observed in the β crystallin proportion in the late stage of cartaract formation. Age-related postsynthetic processes appeared to have taken place in the α crystallin from the control lenses which was reflected in alterations of its subunit composition. X-irradiation of the lens resulted in an early aging of the cortical α crystallin, as reflected by the composition of its subunits, whereas nuclear α crystallin apparently was not affected. (INIS)

29693 ISOTOPE NEPHROGRAPHIC INVESTIGATIONS AFTER EXPERIMENTAL UNILATERAL FRACTIONATED IRRADIATION OF A KIDNEY. Voigt, R.; Arndt, J.; Kriester, A. (Friedrich-Schiller-Universitaet, Jena (German Democratic Republic). Radiologische Klinik und Poliklinik). Fortschr. Geb. Roentgenstr. Nuklearmed.; 123: No. 2, 113-115(Aug 1975). (In German)

2 tabs.; 14 refs.

The left kidneys of rabbits were fractionally irradiated to a total dose of 6,000 R. Renal function was regularly monitored by isotope nephrography. Semiquantitative measurements (Zum Winkel) and comparison of the two sides (Bargon and Emrich) show changes in renal function in the functional and excretory phases; these, however, were less marked than after single dose irradiation. The results are discussed with reference to the relevant literature. (DE)

29694 THE ULTRA-VIOLET RADIATION EFFECTS ON THE ELABORATION OF CONDITIONED DEFENCE REFLEX OF ACTIVE ESCAPE. Dantsig, I. A. (Ministerstvo Zdravookhraneniya SSSR, Moscow. Nauchno-Issledovatel'skij Inst. Gigieny Vodnogo Transporta). Byull. Eksp. Biol. Med.; 78: No. 12, 9-11 (Dec 1974). (In Russian)

For English translation see the journal Bull. Exp. Biol. Med.

The effect of long-term uv irradiation on the higher nervous system activity of mice was studied. Irradiation with suberythemous doses had a favorable effect on the rate of production of conditioned defense reflexes of active escape. Of the two irradiation schemes—constant and gradually increasing doses—the latter was shown to be more effective. (tr-auth)

29695 THE IRRADIATION EFFECT ON THE ALLOGENEOUS INHIBITION PHENOMENON. Lemeneva, L. N.; Chertkov, I. L. (Tsentral'nyj Inst. Gematologii i Perelivaniya Krovi, Moscow (USSR)). Probl. Gematol. Pereliv. Krovi; 19: No. 11, 45-52(Nov 1974). (In Russian)

For English translation see the journal Probl. Hematol. Blood Transfus.

Preliminary irradiation of mice recipients, strain $(CBAXC_{57}Bl)F_1$, with x rays in doses of 150 to 450 R or in doses from 350 to 800 rads caused a 5 to 10 fold attenuation of repression of colony-

forming units (KOE) when bone marrow of strain $C_{57}B1$ was transplanted in them. The effect of preliminary irradiation was specific i.e., it did not affect the number of colonies producing bone marrow. Attenuation of the KOE repression started after 8 to 15 days and then decreased and disappeared after 1.5 to 2 months. The KOE was depressed by preliminary irradiation regardless of the KOE source (adult bone marrows or embryonic liver) and of its condition (non-proliferation KOE of bone marrow in a stable state or KOE of different radiation chimeras). The probability of existence of stromal cells due to KOE repression and the possibility of the effect of preliminary irradiation on them are discussed. (tr-auth)

29696 A COMBINATION OF CHEMICAL RADIOPROTECTORS—ITS EFFECT ON THE SURVIVAL OF IRRADIATED RATS. Nikolov, I.; Pantev, T.; Bokova, N. (Nauchno-Izsledovatelski Inst. po Radiologiya i Radiatsionna Khigiena, Sofia (Bulgaria)). Acta Med. Bulg.; 2: No. 1, 7-12(1974).

The effectiveness of a combination of three chemical radioprotectors against whole body x irradiation was studied. ATP, serotonin and Y-64 were used. Y-64 is S-2-benzimidazolyd mercaptopropio-N-(p-tplyl) hydrazimide dihydrochloride, compound synthesized by the authors, with good radioprotective properties when singly administered. The decrease of the oxidation/reduction potential in the rat's thigh muscle, induced independently and in combination, served as a criterion for the determination of the single doses of each compound. On the ground of the results obtained the isobols of the double combinations were worked out and the optimal triple combination was determined by means of a special bologram as follows: ATP- 50 mg/kg. Y-64–60 mg/kg, and serotonin–7 mg/kg, which displayed at 145 ± 5 mV lowering of the redox potential in the rat's muscle. The radioprotective effect of the combination was estimated in the dose range 500 to 1000 R by the survival and average life span of the dead animals. The dose reduction factor calculated on the basis of $LD_{50/30}$ was equal to 1.70. The difference in the inclination of the lines in the control and experimental groups showed that at higher doses the protective effect of the combination was stronger. There was no essential difference in the protective action of the combination for gastrointestinal and bone marrow forms of radiation death. It might be supposed that the strong protective effect derived from the combination of the three radioprotectors in reduced doses was a matter of super additivity, e.g., synergism or rather a ATP induced potentiation of the radioprotective effect of the two protectors (serotonin and Y-64). (INIS)

29697 THE RADIOPROTECTIVE EFFECT OF CYTRIPHOS IN SHORT TERM AND PROLONGED GAMMA IRRADIATION. Pantev, T.; Bokova, N.; Nikolov, I. (Nauchno-Izsledovatelski Inst. po Radiologiya i Radiatsionna Khigiena, Sofia (Bulgaria)); Rogozkin, V.; Sbitneva, M.; Chertkov, K. (Institut Giprotsvetmetobrabotka, Moscow (USSR)). Acta Med. Bulg.; 2: No. 2, 50-57(1974).

The radioprotective effectiveness of Cytriphos (adenosine triphosphate salt of cysteamine) is studied. The determination of the acute toxicity for mice of Cytriphos show that LD_{50} amounted to 353 mg/kg (307-406) as related to the basis (1700 mg/kg ATP salt). Cytriphos is 1.2 times less toxic as compared to the hydrochloride of cysteamine for which LD_{50} is 293 mg/kg (232-369). Administration of Cytriphos prior to short term γ irradiation exerts a strong radioprotective effect. 750 mg/kg is the optimal radioprotective dose in the dose range studied (95 to 850 mg/kg). Besides by the survival test (dose reduction factor equal to 1.75) the protective action of Cytriphos is manifested by other indicators: number of bone marrow cells in the femur, number of endogenous cellular colonies in the spleen, the weight of the same organ and the animals' body weight. The radioprotective effectiveness of Cytriphos is sustained at a sufficiently high level also under the condition of prolonged irradiation with 835 and 900 R lasting for 4 hours. Cytriphos given after irradiation led to a deterioration of the course of the radiation disease. (INIS)

29698 CARBOHYDRATE DIET PROPHYLAXIS OF THE SEROTONIN INDUCED STRESS. Petkova, M.; Tsochev, Ts. (Meditsinska Akademiya, Sofia (Bulgaria). Katedra po Patofiziologiya). Acta Med. Bulg.; 2: No. 1, 13-17(1974).

The changes in some of the stress-activity indices under conditions of preliminary intensification of this particular mechanism through peroral glucose for two days are followed up. A high dose serotonin (50 mg/kg) is used as a stress stimulant in rats. The following indices are traced: weight of the adrenal glands, ascorbic acid content in the adrenals, blood sugar level, count of eosinophilic cells in the peripheral blood. The two day carbohydrate diet diminishes the high-dose serotonin, induces stress exhaustion of the adrenal glands, followed up by the stress activity indicators–content of ascorbic acid and weight of adrenals. And just the opposite, the same carbohydrate diet intensifies the eosinopenic and hyperglycemic action of serotonin, which could likewise be interpreted as an expression of an enhanced activity of the organism. (INIS)

29699 DIFFERENTIATION OF HEMOPOIETIC AND STROMAL ELEMENTS OF EXTRAMEDULLARY BONE MARROW TRANSPLANTS IN IRRADIATED RECIPIENTS. Starostin, V. I.; Sludskaya, A. I. (AN SSSR, Moscow. Inst. Biologii Razvitiya). Ontogenez; 5: No. 5, 518-520(1974). (In Russian)

In mice irradiated with 700 R, stimulation of the growth of bone marrow transplants, placed under the kidney capsule of mice, was stimulated by 700 R irradiation. The increase in size of the transplants was due, chiefly to hemopoietic tissue growth and the osteogenic potential of the stromal elements was maintained at a high level. Indications of a decrease in viability of the hemopoietic cells were noted, which may have been due to partial stagnation in the sinusoid capillaries. (tr-auth)

29700 MODE OF ACTION OF HETEROLOGOUS ANTILEUKEMIC SERA. Growth of Syngeneically Transplanted Leukemias in Serum-Treated Sublethally Irradiated Mice. Milleck, J. (Zentralinstitut fuer Krebsforschung, Berlin). Arch. Geschwulstforsch.; 45: No. 1, 40-45(1975). (In German)

Heterologous antisera against mouse leukemias prevented the outgrowth of syngeneically transplanted leukemia cells only in nonirradiated but not in sublethally irradiated animals. Mice irradiated with 500 R and controls were subcutaneously injected with 50,000 leukemia cells at the day following irradiation. They were given five injections each of 0.1 ml of heterologous antiserum. While 22 out of 27 irradiated mice developed tumors, nonirradiated controls were protected; only 2 out of 30 animals developed a tumor. Cytotoxicity tests with leukemia cells as targets and mouse serum as complement source showed that the complement activity of mouse serum had not been suppressed by the whole body irradiation. We suppose a cooperation between heterologous antiserum and a radiosensitive host cell as responsible for the antileukemic effect. (auth)

29701 LOCOMOTOR DAMAGE IN RATS AFTER X-IRRADIATION IN UTERO. Mullenix, P.; Norton, S.; Culver, B. (Univ. of Kansas, Kansas City). Exp. Neurol.; 48: No. 2, 310-324(Aug 1975).

Alterations in gait were found in rats after whole-body irradiation with 125 R on day 14, 15, and 16 of gestation. No effects on locomotion were detected after irradiation on day 17 with 125 R or after irradiation on day 14 with 50 R. A technique was set up for quantitative evaluation of locomotion based on a modification of other methods. Walking patterns of irradiated rats were recorded, when they were adults, by requiring them to walk up a 10^0 incline through a corridor after their feet had been dipped in ink. Rats irradiated on gestational day 14 had an in-phase, hopping gait with the sine of the angle between the hind feet and the direction of progression over 0.9. Rats irradiated on gestational days 15 and 16 had an alternating, waddling gait with wider stance and broader angle than control rats. Histologic examination of serial sections of the brains of these rats showed that the 14-day rats lacked all telencephalic commissures except for a few fibers which crossed in some rats. There was a progressive improvement in the condition of the anterior and ventral hippocampal commissures up to day 17, but the corpus callosum and doral hippocampal commissure were lacking or markedly reduced in all day 17 rats. No animals showed damage to the mesencephalic posterior commissure. Since rats which used the in-phase mode of locomotion were never observed to use alternating gait, the possible causal relationship of the commissural damage to the altered locomotor patterns was considered. In view of the restricted period of damage found for the anterior and ventral hippocampal commissures and the restriction of altered locomotion to damage in the same period, primary involvement of the corpus callosum and dorsal hippocampal commissure could be excluded, but a possible role for the other telencephalic commissures remained. (auth)

29702 DEFECTIVE GASTROINTESTINAL RECOVERY AFTER IRRADIATION IN W/W/sup v/ MICE. Torok, B. J.; Boggs, S. S. (Univ. of Pittsburgh). Am. J. Physiol.; 228: No. 4, 1280-1283 (Apr 1975).

W/W/sup v/ mice are white, sterile, and have macrocytic anemia, all due to defective function of pertinent stem cell compartments. Sterility and coat color reflect stem cell failure during embryogenesis, while anemia results from a defective hematopoietic stem cell system which is active throughout life. Studies of radiation damage and recovery were undertaken to determine if the stem cell compartment of the intestinal mucosa, also active throughout life, is likewise affected. W/W/sup v/ mice "cured" of their hematopoietic defect, and normal littermates were exposed to 1250 rads of whole-body irradiation. Mean survival time of controls was 8.4 ± 0.31 days compared to only 5.85 ± 0.18 days (P equals less than 0.001) for W/W/sup v/. Incorporation of

^{3}HTdR into mucosal cells of controls was minimum 2 days after exposure and exceeded nonirradiated levels by day 3, W/W/sup v/ values were lower than controls on days 2 to 4 and never significantly exceeded nonirradiated values. Changes in gut weight followed the same pattern. These studies suggest that the W/W /sup v/ defect involves stem cells of the gut and that the defect is a failure to proliferate and/or differentiate. (auth)

29703 MITIGATION OF GRAFT-VERSUS-HOST DISEASE IN LETHALLY IRRADIATED MICE GRAFTED WITH SPLEEN CELLS ADHERENT TO GLASS BEADS. Gambrill, M. R.; Ledney, G. D.; MacVittie, T. J. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Transplantation; 21: No. 3, 247-254(Mar 1976).

Murine spleen cells were separated on the basis of adherence to glass beads into distinct subpopulations that differ in their ability to produce acute graft-versus-host disease (GVHD). Nonadherent CBA spleen cells produce acute GVHD in 6 to 10 days in lethally irradiated (C57BL/6 x CBA)F_1 mice as do unfractionated spleen cells. Spleen cells which are adherent to glass beads, however, enable 71 percent of the mice to survive without symptomatology of acute GVHD. The low proliferative response of these cells to phytohemagglutinin (PHA) correlated with the mitigated GVHD seen in animals grafted with this fraction. Proliferative cells as determined by the spleen colony assay and the in vitro agar colony-forming assay are present in this fraction as are cells responsive to mitogenic stimulation with lipopolysaccharide (LPS). B6CBF$_1$ mice grafted with CBA adherent cells exhibit a gradual return over a period of 5 months to normal PHA and LPS stimulation levels as shown by splenic cell responses of these mice to mitogens. Surviving mice grafted with adherent cells were chimeric as determined by electrophoretic hemoglobin pattern analysis and serial bone marrow transplantation. (auth)

29704 INTERACTION MECHANISMS OF RADIOACTIVE, CHEMICAL, AND THERMAL RELEASES FROM THE NUCLEAR INDUSTRY: METHODOLOGY FOR CONSIDERING CO-OPERATIVE EFFECTS. Streffer, C. (Univ., Essen). pp 3-13 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

A number of chemicals are known which can modify radiation effects on cell killing, carcinogenesis and mutagenesis. In this paper data are reported for radiosensitizing agents. In order to discuss the interaction mechanisms of these synergistic effects, the action of radiation on DNA, on its biological functions and on its metabolism are explained briefly. Also it is indicated that part of the radiation effects in the DNA can be "repaired" and that living cells can recover from radiation damage. One group of radiosensitizers interacts with cellular DNA or with the DNP-complex. These reactions change the configuration structure or metabolism of DNA and DNP. In this connection the action of antibiotics such as actinomycin D, and the action of SH-blocking agents such as iodoacetamide and NEM, as well as the action of alkylating agents, are discussed. A second group of radiosensitizers, especially with hypoxic cells, are the electron affinic chemicals like nitro-compounds, ketones and others. Data are also given on the modification of radiation effects by changes in temperature. Further, the problem of whether synergistic effects are to be expected arising from the chemicals and radiation originating in the nuclear industry is considered. Data show that repair and recovery processes especially are modified by radiosensitizers. The implications of this fact on sensitization at low radiation doses and at low dose rates, as well as the effect of high LET radiation, are considered. It is of interest that the dose modifying factor of some sensitizers can reach a magnitude of a factor of two to three. (auth)

29705 CHANGES IN VESSELS OF TEETH AND JAWS AFTER LOCAL γ IRRADIATION. Nazarov, G. I. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 20: No. 8, 75-76(Aug 1975). (In Russian)

The effect of local fractionated γ irradiation on the blood vessels of the lower jaw of rabbits exposed to a single fraction of 300, 600, 900, 3000, and 6000 rad was studied by microangiographic methods. During filling of the arterial system of the teeth and jaws, the contrast medium reaches the peripheral arteries and precapillaries but does not reach the venous channels in the control animals. In animals receiving fractioned dose of 300 rad at a total dose of 600 and 900 rad hypervascularization was observed, which appeared in wave-like fashion. Local irradiation to 3000 and 6000 rad led preferentially to local distonic type of maladjustment of the blood circulation. Reparation of the radiation damage was observed within 15 to 30 days. (JSR)

29706 INJURY OF THE CRYSTALLINE LENS DURING EXTERNAL IONIZATION RADIATION. Milovidova, I. A. Med. Radiol.; 20: No. 8, 77-82(Aug 1975). (In Russian)

A review is presented of the clinical and experimental studies of injuries caused to the crystalline lens by external radiation. (JSR)

29707 SIGNIFICANCE OF AIR TEMPERATURE AND UV-RADIATION IN THE RESISTANCE OF ANIMAL ORGANISM TO HEXACHLOROBENZENE. Gabovich, R. D.; Murashko, V. A.; Timoshenko, Ya. G. (Kiev Medical Inst.). Gig. Sanit.; No. 8, 17-21(1975). (In Russian)

Determinations conducted on serum alkaline phosphatase activity, gas exchange, reflex time, hepatic cholinesterase activity, adrenal ascorbic acid levels, hepatic tissue dye absorption, hepatic weight coefficients, body weight dynamics and the Bromsulphalein retention test showed that chronic (three months) administration of hexachlorobenzene (HCB; exposure to HCB dust, 59 ± 5.1 mg/cu.m, 4 hr/day) to sexually mature male rats resulted in a deterioration of their physiological state. Similar deterioration was evident in animals deprived of sunlight, maintained under conditions of elevated air temperature (34-36°, 50-60% relative humidity), exposed to high dose uv radiation (2000 μerg/sq. cm, 4 hr/day), or to a combination of elevated temperature and uv light (2000 or 400 μer/sq. cm). Animals exposed to optimum level of uv light (400 μer/sq.cm, 4 hr day) were in the most satisfactory physiological condition; further, this level of uv exposure counteracted the toxic effects of HCB. Exposure of HCB-treated animals to high dose uv light alone or in combination with elevated temperature potentiated the toxicity of the chemical agent. (JPRS)

29708 INCORPORATION OF LABELED AMINO ACIDS INTO PROTEINS OF THE CELL ORGANELLES OF MUSCLE TISSUE DURING THE RESTORATION OF THE REGENERATIVE CAPACITY OF THE LIMBS OF AXOLOTL, SUPPRESSED BY X IRRADIATION. Teplitz, N. A. (Inst. of Developmental Biology, Moscow). Sov. J. Dev. Biol. (Engl. Transl.); 5: No. 4, 344-349(1974).

Translated from Ontogenez; 5: No. 4, 391-397(1974).

The incorporation of labeled amino acids into the total proteins of muscle tissue and cell organelles during the regeneration of limbs of axolotls and after the suppression of the regenerative capacity by x-irradiation and its experimental restoration were investigated. In the case of suppression of the regenerative capacity of the limbs by x-irradiation, the protein synthesis in the muscle tissue is impaired. The intensity of the incorporation of labeled amino acids into the proteins of a homogenate of muscle tissue, nuclei, mitochondria, and the mitochondria-free fraction is reduced in comparison with normal regeneration. Under the influence of biopreparations (a salt extract from a homogenate of the rat gastrocnemius muscle), a restoration of protein synthesis, processes of differentiation, and the formation of regenerates was observed. (auth)

29709 ANTIRADIATION COMPOUNDS XV: CONDENSATIONS OF CARBON DISULFIDE WITH AMINO, CHLORO, CYANOMETHYL, AND SULFONAMIDO HETEROCYCLES. Foye, W. O.; Kauffman, J. M.; Lanzillo, J. J.; LsSala, E. F. (Massachusetts Coll. of Pharmacy, Boston). J. Pharm. Sci.; 64: No. 8, 1371-1374 (Aug 1975).

Condensations of carbon disulfide were carried out with amino, chloro, and diamino heterocycles to give condensed ring thiazoline-2-thiones and imidazoline-2-thiones, with cyanomethyl heterocycles to give dithio acid derivatives, and with heterocyclic sulfonamides to give sulfonyldithiocarbamates. Of several examples tested, pyrido[3,2-d]thiazoline-2-thione, disodium 2-(5-chloro-2-thienyl)-3,3-dimercaptoacrylonitrile, triethylammonium 4-sulfamoylphenyldithiocarbamate, ammonium beta-phenethyldithiocarbamate, and methyl N-(thiophene-2-sulfonyl)dithiocarbamate, only the last-named compound showed any radiation protection for mice. Several compounds gave negative tests for antimalarial activity.

29710 ASSOCIATION OF IMMUNITY AND TOLERANCE TO HOST H-2 DETERMINANTS IN IRRADIATED F_1 HYBRID MICE RECONSTITUTED WITH BONE MARROW CELLS FROM ONE PARENTAL STRAIN. Sprent, J.; von Boehmer, H.; Nabholz, M. (Basel Inst. for Immunology). J. Exp. Med.; 142: No. 2, 321-329 (1 Aug 1975).

Semiallogeneic radiation chimeras were prepared by injecting heavily irradiated F_1 hybrid mice with bone marrow cells from one parental strain; the bone marrow cells were treated with anti-theta serum and complement to remove T cells and injected in large numbers (2 x 10^7 cells). The mice survived in excellent health until sacrifice 6 mo later. Thoracic duct cannulation at this stage showed that the mice possessed normal numbers of recirculating lymphocytes. Close to 100 percent of thoracic duct lymphocytes and lymph node cells were shown to be of donor

strain origin. The capacity of lymphocytes from the chimeras to respond to host-type determinants was tested in mixed leukocyte culture and in an assay for cell-mediated lympholysis (CML). Mixed leukocyte reactions (MLR) were measured both in vitro and in vivo; tumor cells and phytohemagglutinin-stimulated blast cells were used as target cells for measuring CML. While responding normally to third party determinants, cells from the chimeras gave a definite, though reduced MLR when exposed to host-type determinants. However, this proliferative response to host-type determinants, unlike that to third party determinants, was not associated with differentiation into cytotoxic lymphocytes.

29711 MYELOID REGENERATION AFTER WHOLE BODY IRRADIATION, AUTOLOGOUS BONE MARROW TRANSPLANTATION, AND TREATMENT WITH AN ANABOLIC STEROID. Ambrus, C. M.; Ambrus, J. L. (Roswell Park Memorial Inst., Buffalo). J. Med. (Westbury, N.Y.); 6: No. 1, 27-32(1975).

Stumptail monkeys (Macaca speciosa) received lethal whole-body radiation. Autologous bone marrow injection resulted in survival of the majority of the animals. Treatment with Deca-Durabolin, an anabolic steroid, caused more rapid recovery of colony-forming cell numbers in the bone marrow than in control animals. Both the Deca-Durabolin-treated and control groups were given autologous bone marrow transplantation. Anabolic steroid effect on transplanted bone marrow colony-forming cells may explain the increased rate of leukopoietic regeneration in anabolic steroid-treated animals as compared to controls. (auth)

29712 EFFECT OF HYPERTHEMIA ON THE REPAIR OF RADIATION DAMAGE IN PLATEAU PHASE CELLS. Harris, J. R.; Murthy, A. K.; Belli, J. A. (Harvard Medical School, Boston). Radiology; 119: No. 1, 227-229(Apr 1976).

From 62nd scientific assembly and annual meeting; Chicago, IL, USA (14 Nov 1975).

Hyperthemia (41^{0}C for 1 hr.) completely inhibited both sublethal and potentially lethal radiation damage repair by plateau phase cells taken from V79 Chinese hamsters. This suggests that there may be disadvantages in combining x-ray and heat therapies for the treatment of tumors. (auth)

29713 LATE CHANGES IN THE IRRADIATED MICROVASCULATURE: AN ELECTRON MICROSCOPE STUDY OF THE EFFECTS OF FISSION NEUTRONS. Stearner, S. P.; Devine, R. L.; Christian, E. J. B. (Argonne National Lab., IL). Radiat. Res.; 65: No. 2, 351-370(Feb 1976).

Microvascular changes in the pinna were studied in vivo and recorded photographically over a period of 12-18 months after irradiation of 4-month-old B6CF$_1$ mice. Radiation treatment consisted of total-body exposure to 240 rad fission neutrons either in a single dose or in 72 fractions of 3.3 rad each over 24 weeks. Neutrons with a mean energy of 0.8 MeV were supplied from the JANUS reactor. A fission neutron dose of 240 rad is below the acutely lethal range. At 20 months after treatment, after a series of in vivo observations of the microvasculature, animals were sacrified for study of changes in vascular fine structure in the pinna. Blood vessels were selected from regions that had been identified on photomicrographs. After single or fractionated neutron exposures, the surviving functional blood vessels had relatively minor late ultrastructural changes in the endothelium. Many arterioles, however, showed extensive degenerative changes in the subendothelial intima (including the elastica) and marked necrosis of smooth muscle. Accumulations of fibrillar material and debris frequently occupied much of the media and replaced regions of smooth muscle lost by focal necrosis. Arteriolar degeneration and sclerosis appeared to be more extensive after fractionated treatments. Corresponding small veins or venules also showed smooth muscle degeneration and increased fibrosis, but changes were somewhat less severe than in arterioles. Capillary changes included a thickened basal lamina and increased fibrosis. Endothelial swelling and increased vacuolization were sometimes observed. (auth)

29714 EFFECTS OF X IRRADIATION ON LIVER RNA METABOLISM IN SPECIFICALLY SHIELDED RATS. Abdel-Halim, M. N.; Yatvin, M. B. (Univ. of Wisconsin, Madison). Radiat. Res.; 65: No. 2, 327-336(Feb 1976).

The mechanism(s) of action of ionizing radiation on RNA synthesis, processing, and transport was studied in liver of intact and adrenalectomized male rats exposed to 1800 rad. The animals were whole-body irradiated; were irradiated to the liver only, with the rest of the body shielded; had the liver shielded and the rest of the body irradiated; or served as unirradiated controls. Newly synthesized RNA as measured by ½-hr uptake of (6-^{14}C)orotic acid was determined in various cell fractions at times ranging from ½ to 72 hr after either laparotomy or exposure to irradiation. The major response was an increase in polyribosomal specific radioactivity 3 and 6 hr after exposure in adrenal intact animals. Adrenalectomy 3 days prior to treatment prevented the increase. Two phases were observed in the liver exteriorization studies. In the first phase (0-48 hr), when RNA synthesis was enhanced, it appeared to be mainly adrenal-mediated. In the second phase (72 hr), however, when increases in both RNA synthetic rate and transport were observed, the action on the liver was direct. (auth)

29715 EFFECTS OF X RADIATION AND URETHANE ON SURVIVAL AND TUMOR INDUCTION IN THREE STRAINS OF RATS. Myers, D. K. (Chalk River Nuclear Labs., Ont.). Radiat. Res.; 65: No. 2, 292-303(Feb 1976).

Groups of Sprague–Dawley, Long–Evans, and Collip rats were exposed at 5 to 10 weeks of age to repeated high dose of x-radiation alone, urethane alone, or x-radiation plus urethane at the same time. Cumulative mortality and tumor incidence were measured until the animals reached 17 months of age. The final cumulative incidence of mammary tumors was highest in the Sprague–Dawley rats and lowest in the Collip rats, while the final cumulative incidence of skin tumors and fatal lymphatic disorders showed the opposite trend. X-radiation and urethane together produced more lymphatic disorders but fewer skin and mammary tumors than expected from the sum of the effects of the two agents separately in Collip rats. However, these results were not always paralleled by those obtained in the other two strains of rats. As judged from the cumulative mortality curves for all three strains of rats tested, it would appear that the overall carcinogenic stimulus and life-shortening effect of x-radiation and urethane together was not greater than the sum of their separate effects at the dosage levels studied. (auth)

29716 SMALL-FIELD IRRADIATION OF MONKEY EYES WITH PROTONS AND PHOTONS. Constable, I. J. (Eye Research Inst. of Retina Foundation, Boston); Goitein, M.; Koehler, A. M.; Schmidt, R. A. Radiat. Res.; 65: No. 2, 304-314(Feb 1976).

The relative biological efficiency (RBE) of a 7 mm diameter proton beam was compared to a 6.25 mm 2 MV photon beam by measuring their relative effects in owl monkey eyes. We chose as the endpoint the appearance of a circumscribed patch of choroiretinal edema 2 days after a single dose. Both unmodulated protons and modulated proton beams showed an RBE close to unity. Dose is critically dependent on the position of the Bragg peak relative to the retina and choroid. Irradiation with modulated protons in five fractions once per week produced a marked tissue-sparing effect; no clinical or histological effects were evident 1 yr later, until a total dose of 12,500 rad or more had been delivered. These experiments are of importance to the planning of small-beam therapy of eye tumors. They demonstrate that carefully collimated narrow beams can deliver a tissue-destroying dose to a localized area of retina and choroid, while causing minimal damage to adjacent normal tissue. (auth)

29717 CALCULATION OF THE RADIATION DOSE TO THE TRABECULAR SECTION OF A RAT FEMUR. Yalcintas, M. G. Rochester, NY; Univ. of Rochester (1975). 112p. University Microfilms Order No. 75-24,474.

Thesis (Ph. D.).

The size of the cavities in trabecular and shaft marrow of the rat femur have been determined utilizing Zeiss size analyzer and the distribution curves were obtained. The degree of filling of these spaces with radioinsensitive circulating blood in the sinusoids has been estimated. The theoretical average doses to hematopoietic tissues in these cavities have been calculated with or without considering the sinusoidal blood volume and blood vessels in bone marrow. The effects of various doses on the uptake of ^{59}Fe in the hematopoietic system has been determined for three different x-ray energies (80 kVp, 150 kVp, 1000 kVp) and it has been shown that the effects of x irradiation for the dose on the marrow may differ with the different methods of dose determinations with or without taking into account the sinusoidal blood volume and blood vessels in bone marrow. (Diss. Abstr. Int., B)

29718 EFFECT OF COBALT-60 AND NEUTRON IRRADIATION UPON THE IMMUNE RESPONSE OF TUMOR BEARING DOGS. Barratt, N. P. College Station, TX; Texas A and M Univ. (1975). 73p. University Microfilms Order No. 75-25,079.

Thesis (Ph. D.).

The immune system, a major host defense mechanism against malignant cells, is affected by total body irradiation with ^{60}Co or with neutrons. Evidence is presented that there is an effect upon the humoral immune response of tumor bearing and non-tumor bearing dogs by therapeutic doses of ^{60}Co and of neutrons. This effect was apparent even though irradiation was given to areas which would not be considered a vital part of the immune system. There was no apparent effect upon the cell mediated response. These effects from therapeutic irradiation conformed to the pattern which has been established for total body irradiation. (Diss. Abstr. Int., B)

29719 PRENATAL EFFECTS OF ANCESTRAL IRRADIATION IN INBRED MICE. Sprackling, L. E. S. Fort Collins, CO; Colo-

rado State Univ. (1975). 158p. University Microfilms Order No. 76-4331.

Thesis (Ph. D.).

Mice from 12 inbred strains (S, Z, E, Bab, BaB, BrR, C, K, N, Q, G, CFW, CF1) received continuous cobalt 60 irradiation at low dose rates for varying numbers of consecutive generations. Some Bab and BaB mice had received continuous irradiation for from 24 to 31 generations and the other mice had up to six generations of continuous irradiation in their ancestry. At weaning, the mice were removed from the irradiation room and were mated within strains either to sibs or nonsibs. Ancestral and direct irradiation doses were calculated. The ancestral dose was the effective accumulated dose to the progeny of the mated mice. The direct dose was the amount of irradiation received by any mated female from her conception to her weaning. Each irradiated or control female was scored as fertile or sterile and in utero litter counts were made in pregnant females that were dissected past the tenth day of pregnancy; the sum of moles, dead embryos, and live embryos was the total in utero litter size. A ratio of the living embryos to the total number of embryos in utero was determined for each litter. An increase in ancestral or direct irradiation dose significantly decreased fertility in 11 of the 13 strains. The fertility curves for the pooled data were sigmoid in the area of the doses below those that caused complete sterility. Among the controls, there were significant strain differences in total litter size and in the ratio. Strain X–Y plots, with ancestral or direct doses plotted against total litter size or ratio, revealed the tendency for litter size to decrease as dose increased. The only trend shown for ratio was for the litters with ratios of 0.50 or less to appear more frequently among the irradiated mice. The few corpora lutea counts revealed nothing of significance. Generally, there was a definite trend toward fewer mice alive in utero among the irradiated mice. (Diss. Abstr. Int., B)

29720 HOST IMMUNE REJECTION OF TA3 ASCITES CARCINOMA CELLS FOLLOWING ADMINISTRATION OF A WATER SOLUBLE CARBODIIMIDE. Tenforde, T. S.; Fawwaz, R. A.; Grossman, R. A. (Univ. of California, Berkeley). Experientia; 32: No. 2, 231-232(15 Feb 1976). (In French).

Regression of TA3 ascites carcinoma tumors occurred following i.p. injection of 1-ethyl-3-(3'-dimethylaminopropyl)carbodiimide · HCl. An immunological mechanism of drug action was indicated by the fact that no significant antitumor activity was demonstrable in mice that had previously received an immunosuppressive 700 rad dose of ^{60}Co radiation. (auth)

29721 IN VIVO AND IN VITRO ^{3}H-THYMIDINE INCORPORATION INTO BONE MARROW CELLS OF MICE IRRADIATED WITH 200 R. Lipski, S.; Kwiek, S. Jr. (Inst. of Hygiene and Epidemiology, Warsaw). Acta Physiol. Pol.; 26: No. 5, 499-505(1975).

Recovery of the hemopoietic system of mice irradiated with 200 R was studied. Incorporation of ^{3}H-thymidine (^{3}H-Tdr) in vivo and in vitro into bone marrow DNA was investigated by means of autoradiography and determination of radioactivity of extracted DNA. In experiments carried out in vivo, normalization was observed one day after irradiation, and then ^{3}H-Tdr incorporation reached maximum on the third day following irradiation. Also in vitro, normalization was noted but 3 to 5 days after irradiation. The dynamics of changes in the percent of labelled cells studied by autoradiography had similar character. Differences between ^{3}H-Tdr incorporation in vivo and in vitro may be explained by earlier proliferation of erythroblastic cells in vivo, while in vitro, DNA synthesis in erythroblastic cells is delayed.

29722 CHANGES IN THE PHARMACODYNAMICS AND PHARMACOKINETICS OF PSYCHOLEPTIC DRUGS IN RADIATION-SICKNESS. Effect of X-Ray Radiation on Pharmacodynamic Activity of Nitrazepam in Animals. Szczawinska, K.; Chodera, A.; Wojciak, Z.; Kozaryn, I. (Inst. of Biology and Pharmacy, Poznan, Poland). Acta Physiol. Pol.; 26: No. 5, 523-527(1975).

The anticonvulsive effect of nitrazepam was determined in animals exposed to a single 600 R radiation and the exploring activity of the animals was studied after nitrazepam administered during radiation sickness caused by this exposure. On the 1st day after exposure the activity-reducing effect was slightly weaker but on days 3rd and 6th this effect was significantly stronger. The anticonvulsant effect of nitrazepam on the 3rd day after exposure was significantly greater as compared with control animals, but on the 6th day no difference in the power of anticonvulsant activity between the two groups of animals was found.

29723 FACTORS INFLUENCING RADIATION-INDUCED IMPAIRMENT OF RAT LIVER MITOCHONDRIAL OXIDATIVE PHOSPHORYLATION. Alexander, K. C.; Aiyar, A. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay (India). Biochemistry and Food Technology Div.). Indian J. Biochem. Biophys.; 12: No. 1, 35-37(Mar 1975).

The influence of some experimental conditions on the radiation-induced impairment of oxydative phosphorylation in rat liver mitochondria has been studied. Shielding of the liver during whole body irradiation of the animal does not significantly alter the decreased efficiency of phosphorylation. There exists a great disparity in the in vivo and in vitro radiation doses required for the manifestation of damage to liver mitochondria. While these observations point to the abscopal nature of the radiation effects, direct involvement of the adrenals has been ruled out by studies with adrenalectomised rats. Prior administration of the well known radio-protective agents, serotonin or 2-aminoethyl isothiouranium bromide hydrobromide, is effective in preventing the derangement of mitochondrial function following radioexposure. The hypocholesterolemic drug ethyl-α-p-chlorophenoxy isobutyrate, which is known to influence hepatic mitochondrial turnover, does not afford any significant protection against either mitochondrial damage or the mortality of the animals due to whole body irradiation. (auth)

29724 CHANGES IN THE LIVER MITOCHONDRIA OF CHICK EMBRYOS AND CHICKENS TREATED WITH GAMMA RAYS. Todorov, B. (Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria). Veterinaren Institut za Infektsiozni i Parazitni Bolesti). Vet. Med. Nauki (Sofia); 12: No. 4, 106-110(1975). (In Bulgarian).

Studied were the changes in the activity of the mitochondria-specific enzyme malatedehydrogenase (MDH) and the ATP content in the liver of chick embryos and chickens irradiated with 1000 rads. The total activity of MDH rose, but such was not the case of 20-day-old embryos. These changes were most pronounced in 12-day-old embryos. This showed that the changes in the mitochondria depend on the stage of embryonic development. (auth)

29725 EFFECT OF IONIZING RADIATION ON THE COURSE OF AEROSOL INFECTION OF RABBITS WITH AUJESZKY DISEASE VIRUS. Bartoszcze, M.; Roszkowski, J.; Lojek, W. Med. Dosw. Mikrobiol.; 26: 151-156(1974). (In Polish).

For English translation see the journal Exp. Med. Microbiol.

In a dose of 400 R, ionizing radiation affected the course of aerosol infection of rabbits with Aujeszky virus. The virus appeared sooner in blood, its titer in the organs was higher, survival time of the animals was shorter, and development of histologic changes in the trachea and lungs was accelerated. (auth)

29726 RADIATION EFFECTS ON MUSCLE: ELECTRONIC INSTRUMENTATION SYSTEM FOR MEASURING BIOELECTRICAL CELL ACTIVITIES. Portela, A. (Instituto de Investigaciones Biofisicas, Buenos Aires); Llobera, O.; Vaccari, J. G.; Campi, M.; Delbue, M. A.; Perez, J. C.; Stewart, P. A.; Gosztonyi, A. E. Stud. Biophys.; 52: No. 3, 197-207(1975).

An Electronic Equipment System was designed for performing sequentially, the following set of bioelectrical measurements on muscle cells, by means of intracellular microelectrode techniques: resting potentials and passive electrical membrane parameters, threshold stimuli amplitude, action potential propagation velocity, and dynamic electrical parameters of the active excitable membrane. Block diagrams of interconnections of part components, switching, calibration procedures and details of electrical measurements are described. The system permits recordings of membrane potential signals simultaneously in the phase plane (V, dV/dt) and in the conventional coordinate system (V,t); the magnitude of electrical current for evoking cell membrane responses and additional recordings for determining those parameters, are indicated. The analytical methods for calculating the cable passive parameters and those related to the ionic current associated with the propagated action potential, ionic conductances, etc., from data recorded by means of this Electronic Set up System, were described in the previous paper (Part I). (auth)

29727 DETECTION OF THE EFFECT OF IONIZING IRRADIATION BY IMPULSE CYTOPHOTOMETRIC DETERMINATION OF THE INCREASE IN UV FLUORESCENCE OF VITAL UNSTAINED CELLS. Merkle, K. (Central Inst. for Cancer Research, Berlin). Stud. Biophys.; 52: No. 3, 233-237(1975).

It has been demonstrated that the technical means available at present allow us to measure the relatively low level of uv fluorescence intensity of vital unstained cells in the impulse regime so as to give a high automation effect, at the same time improving the accuracy of measurement and overcoming the procedurally related drawbacks of the single-cell photometric determination of the fluorescence intensity of vital cells. A cell population irradiated with 800 rad showed, after 5 days, a fluorescence intensity increased by 36% in relation to control cells. Determination of the functional relationship between increase in fluorescence in-

tensity and the dose of irradiation will have to be the subject of further studies. (auth)

29728 VOLUME CHANGES OF MULTICELLULAR SPHEROIDS AFTER IRRADIATION WITH X RAYS. Kopp, J.; Pitra, C.; Handschack, W. (Central Inst. of Molecular Biology, Berlin). Stud. Biophys.; 52: No. 3, 239-240(1975).

In radiobiology a number of models with mammalian cells have been developed to simulate structural and metabolic features of solid tumors. Growth of cells to confluence /1/ and multicellular spheroids /3,4/ may be the best in vitro representation of solid tumors. (auth)

29729 EFFECT OF SINGLE AND LONG-TERM EXTERNAL IRRADIATION ON THE BIOCHEMICAL BLOOD PARAMETERS. Fedorova, A. (Leningradskij Inst. Radiatsionnoj Gigieny (USSR)); Nechev, Kh. (Meditsinka Akademiya, Sofia (Bulgaria). Katedra po Mediko-Sanitarna Zashtita). Rentgenol. Radiol.; 14: No. 1, 20-25(1975). (In Bulgarian).

Experiments were carried out on 375 animals divided in four experimental groups and one control group. A 300 R dose was used for single irradiation; long-term irradiation was carried out over a period of 630 days with daily doses of 5 R, 1 R, and 0,2 R. Blood biochemical parameters characterizing different facets of protein and lipid metabolism and the activities of some enzyme systems served as criteria for assessing the biological effect. Results: single exposure to 300 R induced rapid changes in the blood biochemical parameters with a return to normal by the end of the month. Chronic exposure had a slower effect, but the changes became increasingly more pronounced as the total dose was increased: they were most prominent in the group receiving 5 R daily and less prominent in those receiving 1 R daily. No changes were detected in animals exposed to a daily dose of 0.2 R. (auth)

29730 SURFACE DOSE FROM ELECTRONS IN TISSUE IRRADIATED WITH X-RAYS OR GAMMA RAYS. Hogeweg, B. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 1-3 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29731 DOSIMETRY FOR RAT IRRADIATIONS WITH MONOENERGETIC NEUTRONS. Broerse, J. J.; Engels, A. C.; Bouts, C. J.; Broers-Challiss, J. E. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 8-10 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29732 EFFECTIVENESS OF ACUTE, PROTRACTED, AND FRACTIONATED IRRADIATION ON DIFFERENT REGIONS OF THE RAT SPINAL CORD. van der Kogel, A. J.; Barendsen, G. W.; Sissingh, H. A. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 20-21 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29733 HYPOXIC SENSITIZERS IN FRACTIONATED RADIOTHERAPY OF A POORLY REOXYGENATING TUMOR. van Putten, L. M. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 25-26 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29734 EFFECTIVENESS OF COMBINED TREATMENTS WITH IRRADIATION AND DRUGS EVALUATED FOR A RAT RHABDOMYOSARCOMA. Barendsen, G. W.; Janse, H. C. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 27-28 of REP Annual Report. Rijswijk, Netherlands). Gezondheidsorganisatie TNO (1975).

29735 EXTRACORPOREAL IRRADIATION OF THE BLOOD: A MODEL FOR STUDIES ON CELLULAR KINETICS OF LEUKEMIA. Hagenbeek, A.; Martens, A. C. M. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 29-32 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29736 INFLUENCE OF PRETREATMENT WITH DRUGS OR IRRADIATION ON LUNG NODULE FORMATION AFTER INTRAVENOUS INJECTION OF A TUMOR CELL SUSPENSION. Smink, T.; van Dierendonck, H. H. C. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 37-38 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29737 INVESTIGATION OF MECHANISMS INVOLVED IN ENHANCEMENT OF METASTATIC LUNG NODULES BY CYCLOPHOSPHAMIDE. de Ruiter, J. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 39-40 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29738 RESTORATION OF THE HUMORAL IMMUNITY IN LETHALLY IRRADIATED RHESUS MONKEYS FOLLOWING TRANSPLANTATION WITH AUTOLOGOUS BONE MARROW. van den Berg, P. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands); Loewenberg, B.; Swart, A. C. W.; Radl. J. pp 139-142 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29739 INFLUENCE OF THE THYMUS-DEPENDENT IMMUNE SYSTEM ON THE APPEARANCE OF HOMOGENEOUS IMMUNOGLOBULINS IN SERA AFTER LETHAL IRRADIATION AND BONE MARROW TRANSPLANTATION. van Muiswinkel, W. B. (Erasmus Univ., Rotterdam, Netherlands); van der Wal, D. J.; Radl, J. pp 143-144 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29740 RELATION BETWEEN THE FECAL CONCENTRATION OF A PARTICULAR POTENTIALLY PATHOGENIC MICROORGANISM AND ITS PARTICIPATION IN AN INFECTION IN LETHALLY IRRADIATED MICE. van der Waaij, D.; Tielemans-Speltie, T. M.; de Roeck-Houben, A. M. J. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 235-237 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29741 MORTALITY OF EARLY RECONVENTIONALIZED C. R. MICE AFTER LETHAL IRRADIATION AND ALLOGENEIC BONE MARROW TRANSPLANTATION. Heidt, P. J.; van Bekkum, D. W.; Knaan, S. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 238-239 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

29742 INDUCTION BY X-RAYS OF CHROMOSOME ABERRATIONS IN GERM CELLS OF MALE GUINEA-PIGS, GOLDEN HAMSTERS, AND RABBITS. I. Dose Response in Post-Meiotic Stages. Cox, B. D.; Lyon, M. F. (Medical Research Council, Harwell, Eng.). Mutat. Res.; 29: No. 1, 93-109(Jul 1975).

The induction by X-rays of translocations in post-meiotic germ cells of the guinea-pig, golden hamster and rabbit was studied by cytological analysis of male offspring of the irradiated animals. As reported previously for the mouse, the pattern of sensitivity to dominant lethal induction, as indicated by litter-size, was similar to that for translocation induction in both the guinea-pig and golden hamster. In both species, spermatids were more sensitive than spermatozoa, and in the golden hamster spermatocytes gave a lower yield than spermatids. The translocation frequency among post-meiotic germ cells treated with 600 rad was higher in the rabbit than the guinea-pig, and both were above that for the golden hamster. However, for spermatozoa, species differences with respect to the recovered translocation yield appeared to depend on dose. In the hamster, the translocation frequency after 600 rad, as measured in the female offspring, was similar to that obtained in the male offspring. A small amount of data on the induction of sex-chromosome aneuploidy by 200 rad in golden hamsters suggested that the hamster might be as sensitive as the mouse. (NL)

29743 INDUCTION BY X-RAYS OF CHROMOSOME ABERRATIONS IN MALE GUINEA-PIGS, GOLDEN HAMSTERS, AND RABBITS. II. Properties of Translocations Induced in Post-Meiotic Stages. Cox, B. D.; Lyon, M. F. (Medical Research Council, Harwell, Eng.). Mutat. Res.; 29: No. 1, 111-125(Jul 1975).

Translocations induced by X-rays in post-meiotic germ cells of male guinea-pigs, golden hamsters and rabbits were studied cytologically in the F1 sons of the irradiated males. The percentage of spermatocytes displaying multivalent configurations varied with the translocation, but the average percentage appeared to depend on the species: fewer quadrivalents were observed in hamster than in guinea-pig heterozygotes and most were recorded for rabbit heterozygotes. Chain quadrivalents were more abundant than ring quadrivalents at meiosis for the guinea-pig and hamster in contrast to the mouse. Too few translocation heterozygotes were examined to determine which meiotic configuration was the most prevalent in the rabbit. In all three species, as in the mouse, translocations were found which caused male sterility, due to partial or complete failure of spermatogenesis, although most translocations caused semi-sterility. For these semi-sterile males both the frequency and time of embryonic death in the progeny appeared to be the same as in the mouse. It is concluded that similar types of chromosome aberrations are induced by X-rays in post-meiotic germ cells of male guinea-pigs, rabbits, golden hamsters and mice. (NL)

29744 TESTICULAR ATROPHY AND SUBSEQUENT REGENERATION IN RATS HYPOPHYSECTOMIZED 24 HOURS AFTER TESTES X IRRADIATION. Jovovic, D.; Popovic, A. Iugosl. Physiol. Pharmacol. Acta; 9: No. 3, 301-318(1973). (In Bulgarian).

In hypophysectomized rats postirradiation atrophy, as well as regeneration of the seminiferous epithelium proceeded much faster than in nonhypophysectomized rats. On the 45th day after

exposure the authors found spermatogonia in 89.4% of tubules of irradiated-hypophysectomized rats, but only in 63.8% of tubules of irradiated controls. The difference persisted till the 100th postirradiation day, when 95.7% of tubules of hypophysectomized rats contained spermatocytes, and only 48.2% of irradiated non-hypophysectomized rats. (Bull. Sci., Sect. A)

29745 EFFECT OF DRIED THYROID GLAND PRETREATMENT UPON ERYTHROPOIETIC ACTIVITY AND DEVELOPMENT OF ANAEMIA IN SUBLETHALLY X-IRRADIATED MICE. Pospisil, M.; Netikova, J.; Pipalova, I. (Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague); 20: No. 1, 59-67(1974).

The possibility of a favourable effect of thyroid hormone pretreatment on the postirradiation recovery of erythropoiesis was tested in mice, using ^{59}Fe uptake, newly-formed erythrocyte release, and red blood cell count as criteria. The results show that 21-day peroral administration of the dried thyroid gland in a dose of 0.6 mg. per 100 g diet stimulated erythropoiesis, mainly extramedullary, and led to an increase in the erythrocyte count in the peripheral blood. Postirradiation erythropoietic recovery in mice exposed to a whole-body dose of 450 R was markedly stimulated by thyroid gland pre-treatment. This favourable effect was also manifested in a milder degree of postirradiation anaemia. The effect can be explained by the persistence of a higher level of the red blood cell count and by the activation of erythropoiesis in auxiliary blood-forming organs. (Nuclear Sci. Abstr. Czech.)

29746 BIOLOGICAL EFFECTS OF SOLAR PROTONS ON RAT BONE MARROW. Govorun, R. Veda Tech. SSSR; 2: No. 1, 57-58(Feb 1974). (In Czech).

The results are presented of comparative cytogenetic studies into the quantitative and qualitative laws of the effect of 50, 120 and 645 MeV energy protons on rat bone marrow and of a comparison of the RBE of this radiation, as were conducted by the Institute for Medical and Biological Research in Moscow. It was ascertained that the amount of proliferating cells with chromosomal aberrations is a reliable criterion for evaluation of radiation damage. (Nuclear Sci. Abstr. Czech.).

29747 DEMONSTRATION OF WHOLE BLOOD ANALYSIS USING PROTON-INDUCED X—RAY EMISSION. Malanify, J.J.; Burns, C.E.; Close, D.A.; Bearse, R.C. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). Med. Phys. 3: No. 2, 91-94 (Mar 1976).

The elemental variations in whole blood following γ-radiation injury of mice have been studied. The trace-element analyses were performed using the proton-induced x-ray emission technique, and the results were compared with the red blood-cell count. It is shown that, by using this method, the variation of the six elements, K, Ca, Fe, Cu, Zn, and Rb, can be studied simultaneously. (auth)

29748 EFFECT OF IONIZING RADIATION ON RNA METABOLISM IN RAT LIVER. Abdel-Halim, M. N. Madison, WI; Univ. of Wisconsin (1975). 170p. University Microfilms Order No. 75-18,158.

Thesis (Ph. D.).

The effect of whole-body gamma irradiation (1800 rads) and 5-fluoroorotic acid (5-FOA) on RNA metabolism in liver of intact and adrenalectomized rats was studied. The level of incorporation of (6-^{14}C)orotic acid into liver RNA during a 30 minute pulse was determined in whole homogenate, nuclear, polyribosomal and non-sedimentable hepatocyte fractions of control, irradiated, 5-FOA treated rats and rats receiving both irradiation and 5-FOA. In whole liver homogenate of intact rats, (6-^{14}C)orotic acid uptake was elevated between 1-6 hours and was maximally increased 3 hours after either irradiation, 5-FOA treatment or the combination of both. The uptake of the radioactive label in the non-sedimentable fraction reached a maximum 6 hours after irradiation alone or in combination with 5-FOA. However, 5-FOA alone doubled the specific activity 1/2 hour following injection. In contrast, in adrenalectomized rats, the uptake into the whole homogenate, nuclear and the non-sedimentable RNA fractions was not increased above the control 1/2 hour after treatment with either irradiation alone or in combination with 5-FOA. At 6 hours, after pulse labelling, the specific activities of the three RNA fractions and whole homogenate were below the control value. The effect of x-irradiation (1800 rads) on liver RNA synthesis has been studied in intact and adrenalectomized (Adx) rats. Bilateral adrenalectomy was performed on 180-200 gm male rats 72 hours prior to irradiation. In a second set of experiments, livers of intact rats anesthetized with Nembutal (30 mg/kg body weight) were exteriorized and the animals either: were whole-body irradiated; were irradiated to the liver only with the rest of the body shielded; had the liver shielded and the rest of the body irradiated; or served as unirradiated controls. Newly synthesized RNA as measured by 1/2 hour uptake of (6-^{14}C)orotic acid was determined in whole-homogenate, cytoplasmic, nuclear and polyribosomal fractions of liver at varying times from 1/2 to 72 hours after surgery or exposure to irradiation. In adrenalectomized rats, RNA specific radioactivities in all subcellular fractions of liver were either equal to or less than that of the unirradiated adrenalectomized control.

29749 PATHOGENETIC MECHANISMS IN IMMUNE POLIOENCEPHALOMYELITIS: INDUCTION OF DISEASE IN IMMUNOSUPPRESSED MICE. Duffey, P. S.; Martinez, D.; Abrams, G. D.; Murphy, W. H. (Univ. of Michigan, Ann Arbor). J. Immunol.; 116: No. 2, 475-481(Feb 1976).

Immune polioencephalomyelitis (IPE) was induced by the i. p. injection of x-irradiated (10,000 R) syngeneic line l/sub b/ malignant lymphocytes into C58 mice that were 7 or more months old and in young mice immunosuppressed by x-ray or drugs. The occurrence of IPE in young immunosuppressed C58 mice was systematically analyzed. When mice less than 2 weeks old were x-irradiated with 600 R, IPE could not be induced. The incidence in 1-month-old mice was approximately 50 percent and increased progressively with the age except for a drop in incidence at 3 months. An analysis of the dose effects of x-irradiation on the occurrence of IPE in mice of different ages revealed a marked increase in the incidence in 3- and 5-month-old mice beginning at dose levels of 450 R and 300 R, respectively. Considered together, these data indicated that two sub-populations of immunocytes differing in x-ray sensitivity interacted to protect mice from IPE. It appears that under natural conditions an x-ray sensitive cell population, possibly having suppressor function, decreased with age and made mice susceptible to induction of IPE. Five-month-old mice were immunosuppressed with an LD_{10} of cyclophosphamide, prednisolone, or methotrexate to determine whether mice immunosuppressed with drugs also were susceptible to the induction of IPE. (auth)

29750 SYNTHESIS OF SERUM PROTEINS IN PARABIOTIC MICE AFTER THYMECTOMY AND SUBLETHAL X-IRRADIATION. Godzinska, E. (Jagiellonian Univ., Krakow). Folia Biol. (Krakow); 24: No. 1, 85-96(1976).

In continuation of studies on the role of the thymus in the adult organism, the present investigation was designed to detect differences in the synthesis of serum proteins between mice which had undergone thymectomy and were irradiated with sublethal doses of x-rays in the second and fourth weeks of life. Reactivity to foreign histocompatibility antigens was tested by the method of parabiosis. After irradiation, the 2-week-old experimental animals showed a greater loss of weight, more severe wasting disease, and depression of globulin fractions. In spite of this, they demonstrated a stronger reaction to transplantation antigens in parabiosis than mice which also had the thymus removed but were irradiated in the fourth week of life.

Invertebrates

Refer also to abstracts 29561.

29751 (CENA-BC-013) EFFECTS OF HIGH DOSE OF GAMMA RADIATION ON THE LONGEVITY OF ADULTS OF CALLOSOBRUCHUS MACULATUS (Fabr. 1792) (Col. Bruchidae). Walder, J. M. M.; Wiendl, F. M. (Centro de Energia Nuclear na Agricultura, Piracicaba (Brazil)). Jan 1974. 11p. (In Portuguese). INIS.

The effect of high dosages of gamma radiation on the longevity of Callosobruchus maculatus is reported. The doses utilized were 0, 180, 210, 240, 270, 300, 330, and 360 krad. The number of dead insects was recorded every 12 hours after irradiation. The immediate lethal dose found was around 330 krad. The 190 krad dose was estimated to be the one responsible for reducing the regular longevity of this insect by 50%.

29752 (CENA-BC-024) INFLUENCE OF GAMMA IRRADIATION ON THE MORTALITY OF TRIBOLIUM CASTANEUM (HERBST.). Wiendl, F. M.; Tornisielo, V. L.; Domarco, R. E. (Centro de Energia Nuclear na Agriculture, Piracicaba (Brazil)). Oct 1974. 26p. (In Portuguese). INIS.

The coleopteran insect species Tribolium castaneum (Herbst.) was irradiated with different radiation rates, using a cobalt-60 gamma source of the radial type. The rates used were: 59 580, 15,750, 2 750, 632, 154, 63 and 35 rad/h, corresponding respectively to distances of 10, 20, 50, 100, 200, 300, and 400 cm from the source. The insects were irradiated with two doses, one of 7500 rad and the other of 15000 rad, and for this last one the rate of 35 rad/h was not included. There was a control for each dose. Mortality was checked every seven days, and from data obtained, probable life in days, e_0^x, was calculated for each week. The following values were obtained for the 7500 rad dose: 108.16 (control), 131.08 (10 cm); 137.09 (20 cm) 137.36 (50 cm); 145.50 (100 cm); 161.36 (200 cm); 160.16 (300 cm); 164.46(400 cm). Probable life values for the 15000 rad dose were the following:

295.33 (control); 109.34 (10 cm); 127.54 (20 cm); 200.48 (50 cm); 297.91 (100 cm); 271.60 (200 cm); 301.84 (300 cm).

29753 (IAEA-R-676F) POSSIBILITY OF APPLICATION OF THE STERILE-MALE TECHNIQUE FOR THE CONTROL OF THE ONION-FLY, HYLEMYA ANTIQUA (MEIG.), HISTOPATHOLOGICAL AND CYTOPATHOLOGICAL CONSEQUENCES OF STERILIZING DOSES OF RADIATION. Final Report for the Period 1 November 1969-30 November 1974. Theunissen, J. (International Atomic Energy Agency, Vienna (Austria)). Dec 1974. 19p. INIS.

The development of ovary and testis has been studied in the onion fly (Hylemya antiqua) from larval hatching to the 30-day-old adult. The methods used for germinal cell type identification and for assessing their radiosensitivity, particularly at low doses, permit the study of comparative radiopathology of other insects, even those from different orders. Criteria with regard to the degree of radiosensitivity of the germinal cell types can be formulated from a histological point of view. Reaction patterns of various cell types to irradiation could be discerned, based on their morphological reactions and related pathological symptoms. Thus, the histopathological approach towards the evaluation of radiation damage in insect reproductive organs, especially the testis, has led to a new set of criteria which refer to the morphological identity of the germinal cell types, assessed by using suitable and standardized histological techniques. Their normal morphology can be used as criterion for radiation induced aberrations.

29754 (IAEA-R-1420-F) RESEARCH ON THE COMBINATION METHODS OF MALE ANNIHILATION AND STERILE INSECT TECHNIQUE FOR THE SUPPRESSION OF THE ORIENTAL FRUIT-FLY. Part of a Coordinated Programme on Fruit-Fly Eradication or Control by the Sterile-Male Technique. Final Report for the period 1 October 1973-30 September 1974. Loaharanu, S. (International Atomic Energy Agency, Vienna (Austria)). Nov 1974. 17p. INIS.

The feasibility of effective control of the oriental fruit fly by a combination of the sterile male technique and bait trapping was demonstrated. Large numbers of flies were produced by using Numva bananas for oviposition and as larval medium. Insect dispersal proved uniform. Sterile flies were dye-marked for dispersal studies. A survey indicated that fly populations began to increase in February, reaching a peak in April (with a correspondingly high infestation rate of fruit for March and April) and began to decline in May. Male pupae were sterilized with 10 krad of γ radiation and subsequently mated with normal females. (INIS)

29755 (INIS-mf-1857, pp 68-76) GENERAL DISCUSSION. Heemert, C. van. 27 Mar 1975.

In chromosomal rearrangements in the onion fly Hylemya antiqua (Meigen), induced and isolated for genetic insect control purposes. Studies on cytogenetics and fertility, with emphasis on an x-linked translocation. (Landbouwhogeschool Wageningen (Netherlands)).

The conclusion is argued that a low dose of 0.5 krad of x-rays is most suitable for the induction of chromosomal rearrangements to be used for genetic control purposes. The translocations and inversions obtained are listed and discussed. Some translocations were selected for further experiments which are described in previous changes but are surveyed in this discussion. (INIS)

29756 ULTRAVIOLET LIGHT MICROBEAM IRRADIATION OF THE MICROTUBULES IN SINGLE HELIOZOAN AXOPODIA. Ockleford, C. D. (St. Andrews Univ., Fife, Scotland). Exp. Cell Res.; 93: No. 1, 127-135(Jun 1975).

Irradiation of single axopodia near their distal ends with ultraviolet light induces axopodial retraction which continues for a short period after irradiation has ceased and appears to depend on the reduction in length of a microtubular axoneme. Altering the target site of the microbeam to the mid-point of an axopodium and prolonging the irradiation time results in the amputation of the distal portion of the axopodium. Both retraction and amputation may involve an ultraviolet light dependent breakdown of cytoplasmic microtubules. Axopodia grow out again after retraction and after amputation. The rates of growth of axopodia shortened in both these ways have been compared. Axopodia which have been caused to retract grow at a mean rate which is faster than that of axopodia which have been amputated. (auth)

29757 EFFECT OF X-RAYS ON STRAINS AND SYNGENS OF PARAMECIUM AURELIA DIFFERING IN GENETIC AFFINITY. Komala, Z. (Inst. of Systematic and Experimental Zoology, Krakow). Folia Biol. (Krakow); 23: No. 4, 341-423(1975).

Experiments were carried out on syngens 1, 3, 5, and 9 of Paramecium aurelia. A sublethal dose of x rays was used (about 31 kR). The conjugants were irradiated in the prophase stage of meiotic division. The percentage of surviving clones and the rate of vegetative reproduction were studied. Karyometric investigations of some strains were also performed. The obtained results indicate that the fate and behavior of the progeny (F_1 and F_2) of irradiated conjugants in various syngens of P. aurelia are a reflection of the genetic affinity connecting these syngens. Syngens 1, 3, and 5, which are more closely related, although in different degrees, included the group of more radiation-sensitive strains. As opposed to this the strains of syngen 9 of P. aurelia, which is genetically distant from the former group, were characterized by considerable radiation-resistance. Karyometric investigations revealed that strains differing considerably as the degree of their reaction to radiation also showed considerable differences in the mutual relations of mean volumes of macro- and micronuclei. (auth)

29758 RADIOSENSITIVITY OF EMBRYOS OF LYMNAEA STAGNALIS L. FROM TWO NATURAL POPULATIONS. Famelis, S. A. (Inst. of General Genetics, Moscow). Sov. J. Ecol. (Engl. Transl.); 6: No. 2, 156-158(1975).

Translated from Ekologiya; 6: No. 2, 84-86(1975).

Snails were taken from two populations inhabiting lakes of different trophic character. Eggs were collected and 600 R of γ radiation was administered to embryos in the gastrula stage. The embryos were incubated and development was observed. There was no difference in the survival of unirradiated controls from the two populations. However, there was a significant difference in survival of the irradiated embryos from the two populations. Differences between the two bodies of water from which the snails were collected are discussed. (HLW)

29759 BEHAVIORAL AND ELECTROPHYSIOLOGICAL EVIDENCE FOR THE MECHANISMS INVOLVED IN THE DETECTION OF IONIZING RADIATIONS BY THE CRAYFISH PACIFASTACUS TROWBRIDGII. Rodriguez, A. Corvallis, OR; Oregon State Univ. (1976). 104p. University Microfilms Order No. 75-29,987.

Thesis (Ph. D.).

The light-adapted crayfish, Pacifastacus trowbridgii, displayed a behavioral response to exposure to 300 kV x-rays at exposure rates of 10 to 30 R/s. Within this range, the proportion of subjects that responded increased with an increase in exposure rate. The response latency was inversely proportional to the exposure rate. Ophthalmectomized animals exhibited a similar response with a significantly shorter latency than the intact animals at the same exposure rate (30 R/s). Partial body exposure of ophthalmectomized animals also elicited a behavioral response and indicated that a radiation-sensitive receptor was located in the abdomen. X-ray exposure of the dark-adapted compound eye evoked an electroretinogram (ERG) that was similar to the light evoked ERG. The x-ray evoked ERG amplitude was found to be dependent on total exposure for stimulus durations of 300 ms or less. With stimulus durations greater than 300 ms, the ERG amplitude increased in relation to the logarithm of the exposure rate. Similar responses with light, indicated that the mechanism of interaction may be the same for x-rays. The time course for maximal dark-adaptation, after a 500 ms exposure to 3.85 ft-c of light, was comparable for both x-ray and light exposure (9 min). Differences observed in ERG amplitude between the light and x-ray evoked responses during the initial recovery period can be attributed to absorption of light by migrating accessory pigments or by differential interaction of light with photosensitive pigments in the eye. (Diss. Abstr. Int., B)

29760 RADIOSENSITIVITY OF SYNCHRONIZED TETRAHYMENA PYRIFORMIS W. CELLS. Srinivas, H.; Vakil, U. K.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay (India). Biochemistry and Food Technology Div.). Indian J. Biochem. Biophys.; 11: No. 4, 287-291(Dec 1974).

29761 STUDY ON THE IMMUNOGENIC ABILITY OF EIMERIA TENNELA OOCYSTS FOLLOWING TREATMENT WITH GAMMA RAYS. Penev, P.; Stefanova, M. (Nauchno Uchebno Obedinenie po Zhivotnovydstvo, Sofia (Bulgaria)). Vet. Med. Nauki (Sofia); 12: No. 5, 111-115(1975). (In Bulgarian)

Studied was the immunizing capacity of Eimeria tennela oocysts, treated with gamma rays at the rate of 6000 R, in 10- and 20-day-old chickens. The oocysts sporulated after treatment. Applied at the rate of 50,000 R they showed lower virulence and were capable of inducing resistance to reinfection with non-irradiated oocysts at rates that were three times as much. Following reinfection some birds manifested subclinical coccidiosis but survived. This showed that the immunization with oocysts that had been irradiated with 6000 R had its peculiar aspect. (auth)

29762 EFFECTS OF SPACE BALLOON FLIGHTS ON REPRODUCTIVE ACTIVITY IN PARAMECIUM AURELIA. Planel, H.; Soleilhavoup, J. P.; Croute, F. (Univ., Toulouse). pp 173-180 of Life Sciences and Space Research. XIII. Berlin; Akademie-Verlag GmbH (1975).

From proceedings of the seventeenth plenary meeting; Sao Paulo, Brazil (17 Jun 1974).

Results of studies on the behavior of Paramecium cultures flown in stratospheric balloons and exposed to a high flux of energetic primary and secondary cosmic rays are reported. A constant and significant increase in cellular growth rate was observed when the ceiling duration did not exceed about 6 hours. A stimulating effect appears to occur only for radiation doses lower than 2 mrads. It is likely that the cosmic radiation acts indirectly through the culture medium; control of factors such as temperature and pressure indicates that the effects observed are indeed due to cosmic radiation. Thus cosmic rays have a stimulating effect in addition to their known higher-dose lethal effect. (STAR)

29763 EFFECTS OF X-IRRADIATION OF PUPAE ON AGING OF THE THORACIC FLIGHT MUSCLE OF THE ADULT HOUSE MUSCA DOMESTICA L. Rockstein, M.; Baker, G. T. (Univ. of Miami, FL). Mech. Ageing Dev.; 3: No. 5-6, 271-278(1974).

Administration of single, 10,000 rad x-ray doses to 48-hour old pupae of the common house fly Musca domestica, at a dose rate of 2000 rads per minute, produced no beneficial effects upon the flight ability (as measured by wing beat frequency) in either male or female adults. However, such treatment to the pupae did produce an increase in the initial, as well as the peak level of activity, during the first 24 to 36 hours post-emergence, of arginine phosphokinase in the thoracic flight muscle of adult males produced from such irradiated pupae. At the same time, protein synthesis in the flight muscle, as measured by the rates of incorporation of radioisotope-labeled leucine, valine, and alanine showed a similar, parallel increase for adult male flies from irradiated pupae during the first 24 to 36 hours post-emergence. (auth)

29764 CHARACTERIZATION OF AN ORGAN-SPECIFIC DIFFERENTIATOR SUBSTANCE. Steele, V. E. Rochester, NY; Univ. of Rochester (1975). 132p. University Microfilms Order No. 75-24,471.

Thesis (Ph. D.)

The objectives of this research are to characterize a diffusible brain inhibitory substance, to elucidate its role in the maintenance of anterior-posterior polarity during head or tail regeneration, and to utilize its action in measuring the differentiative integrity of the stem cells following x-irradiation. Crude, cell-free homogenates of whole planarians (Dugesia etrusca) were centrifuged, Millipore filtered, ultrafiltered using Dow Hollow Fibers, chromatographed using Sephadex and Bio-Gel gel filtration media, electrophoresed using a continuous flow paper electrophoresis apparatus, digested by various enzymatic procedures, and ion focused using LKB Ampholine Electrofocusing equipment. The activities of the various fractions were assayed by placing decapitated planarians in the fractions, then, after nine days the resultant regenerated brain volumes were measured. In order to measure the effect that this substance has on the post-irradiation survival of both the whole animal and the differentiative integrity of the stem cells, x-irradiated planarians were decapitated and allowed to regenerate with or without addition of the inhibitory substance. The inhibitory activity is destroyed when the extract is treated with Pronase, but remains unaffected when treated with RNase, DNase, or Lipase. The inhibitory substance migrates toward the positive electrode when electrophoresed, and has an isoelectric point of between pH 4.75 and 5.38 when isoelectrically focused. (Diss. Abstr. Int., B)

29765 GENETIC EFFECTS INDUCED IN DROSOPHILA MELANOGASTER CULTURED ON IRRADIATED GLUCOSE MEDIUM. Sanjeeva Raom, V. M. B. (Osmania Univ., Hyderabad, India). Indian J. Exp. Biol.; 11: No. 5, 400-402(1973).

D. melanogaster was cultured on a medium containing 50 g irradiated glucose, exposed to 200 kR of x rays, in 100 ml of food medium for three successive generations and genetic tests were conducted at each generation. Sex-linked recessive lethals and translocations were screened to study any induced genetic damage and 6 broods of 3 days interval were used for examining the differential response of the male germline. There was a significant difference between the treated and control flies when the total frequencies of sex-linked recessive lethals were taken into consideration, in the 1st, 2nd and 3rd generations, and in the 2nd and 3rd generations for translocations. It is evident from the results that irradiated glucose can act as a weak mutagen in D. melanogaster. (Indian Sci. Abstr.)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 29611, 29613, and 31971.

29766 (IAEA-R-1015F) THE INTERNAL RADIATION DOSE TO THE POPULATION RESULTING FROM RADIONUCLIDES IN THE ENVIRONMENT. Final Report for the Period 1 May 1974-28 February 1974. Feige, Y.; Eisenberg, A. (International Atomic Energy Agency, Vienna (Austria)). Nov 1974. vp. INIS.

Estimates of the National Average Intakes of Sr-90 and Cs-137 for the year 1968-69 are about five pCi/d per person for Sr-90 and about fourteen pCi/d per person for Cs-137. The highest contribution of long-lived radionuclides to the diet was found to be due to the food group including bread and grain products. Fresh fruits and vegetables have relatively low activity, but because of the quantities consumed by the Israel population they become significant. Animal proteins are not consumed in quantities comparable to western countries, but, because of the high levels of Cs-137 in these foods the radionuclide intake is important. Relatively low levels contributed in general by milk and milk products have been reported. The intake from miscellaneous group which includes tea, coffee, chocolate, nuts, etc. cannot be evaluated accurately with the data available at present. Some of the values obtained are very high and the spread is large. In spite of the fact that average daily intakes are small, in some individuals these good items may conceivably become a major source of ingested radioisotopes due to personal dietary habits. The data are analyzed based on different income and family size and on different consumption levels: low consumers, high consumers, very high consumers. For these different consumer groups, variations in food consumption for different economic income groups and for different family size groups are also studied. (INIS)

29767 POSSIBLE FUTURE EFFECTS ON THE POPULATION OF THE FEDERAL REPUBLIC OF GERMANY OF GASEOUS RADIOACTIVE EFFLUENTS FROM NUCLEAR FACILITIES. Schwarz, G. (Kernforschungsanlage, Juelich, Ger.); Bonka, H.; Bruessermann, K.; Brenk, D. pp 193-207 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

In this paper the potential radioecological consequences resulting from an expanded nuclear industry in the Federal Republic of Germany are assessed for a period of about 100 years. The potential spatial total-body dose, and the expected time-dependent dose distribution for the whole population due to radioactive gaseous releases are described considering contributions due to ^{3}H, ^{85}Kr and ^{133}Xe. The results are suitable for indicating the long-term trend of the degree of retention of radioactivity necessary. Moreover, a risk estimation in the form of the expected number of cancer cases is assessed, including effects from aqueous discharges and globally distributed nuclides. (auth)

29768 REGULATION OF RADIATION SAFETY IN WORK WITH NATURALLY RADIOACTIVE SUBSTANCES AT RARE METALS ENTERPRISES. Lyarskii, P. P.; Elovskaya, L. T.; Kapitanov, Yu. T.; Denisov, A. F. (Scientific Research Inst. of Labor Hygiene and Occupational Diseases, Moscow). Gig. Sanit.; No. 9, 34-38(1974). (In Russian).

Experimental exposure of over 3500 white rats to radioactive ore dust, concentrates and products of their transformation that can be encountered at loparitium and zirconium processing plants demonstrated that ca. 200 rem constituted the minimum effective dose. Comparison of the experimental dose-effect data with the clinical state of lungs in workers resulted in the establishment of the fact that substances with alpha activity with specific activity less than 10^{-9} Ci/gm did not present a health hazard. As a result of these findings the permissible levels of dust with alpha radioactivity was decreased from 4 to 2 mg/cu m for loparitium, and from 6 to 2 mg/cu m for zirconium concentrates. (JPRS)

29769 EVALUATION OF RAW FOOD PRODUCTS FOR RADIOACTIVE CONTAMINATION. Prokof'ev, O. N. (Leningrad Scientific Research Inst. of Radiation Hygiene). Gig. Sanit.; No. 9, 112-114(1974). (In Russian).

A flowsheet of analysis and a diagram were presented for determining whether ingestion of radioactive foodstuffs would lead to irradiation of critical organs above allowable limits. Particular data were presented for beta-radiometric data that would result in 1.5 rem irradiation of the descending colon during the first day of intake, as well as activity of individual isotopes that are responsible for irradiation of critical organs: Cs-137-total body, I-131-thyroid gland, and Sr-89 and Sr-90-osseous tissues. Utilization of foodstuffs should be limited if the daily intake would be in excess of 100 mcCi; smaller activities require careful analysis to determine whether a critical organ would receive excess radiation.

29770 ENDOLYMPHATIC IRRADIATION WITH ^{198}Au AND ^{32}P AS IMMUNOSUPPRESSION IN RENAL TRANSPLANTATION. The

Effect on Hematologic and Immunobiologic Parameters. Birkeland, S. A.; Moesner, J.; Kalnaes, O.; Jensen, T. S. (Odense Univ. Hospital, Denmark). Radiat. Res.; 65: No. 2, 371-385(Feb 1976).

Twenty patients with end stage renal disease awaiting kidney transplantation were treated with radioisotopes in an investigation of the immunosuppressive effect of endolymphatic irradiation. Twelve patients received ^{198}Au and eight were treated with ^{32}P. The isotopes were injected into lymph vessels in the foot and localized in the pelvic lymph nodes with only an extremely small release to the blood and urine. The doses given were 2-7.5 mCi ^{198}Au or 0.4-1.5 mCi ^{32}P. The accumulated dose in the lymph nodes was calculated to be approximately 35,000 rad for ^{198}Au and approximately 150,000 rad for ^{32}P. The blood activity was 1.0-0.2 rad. The dose to a kidney graft was calculated to be approximately 20 rad, and the dose to a lymphocyte in the first 6 hr after injection approximately 1500 rad. The results obtained were lymphocytopenia and a depressed immune response measured with blast transformation tests after stimulation with mitogens, antigens, and allogene cells in mixed lymphocyte culture. No effect was observed on bone marrow, immunoglobulins, complements, liver enzymes, spleen-size, or liver size. A small transient fall in erythrocyte count was seen but otherwise no side effects were demonstrated. Thus, the treatment given, with maximum permissible doses, had an effect on the immune response, but as this effect only lasts for a few weeks the treatment has little practical applicability in kidney transplantation. (auth)

29771 NONSECRETORY PLASMA CELL DYSCRASIA FOLLOWED BY ACUTE GRANULOCYTIC LEUKEMIA 25 YEARS AFTER THOROTRAST ADMINISTRATION. Bethlenfalvay, N.C.; Henley, L. B.; Rupp, T. D.; Phyliky, R. L. (Brooke Army Medical Center, Fort Sam Houston, TX). Cancer; 37: No. 3, 1449-1453 (Mar 1976).

Twenty-three years after an injection of Thorotrast, profound depression of humoral and cellular immunity associated with extensive marrow plasmocytosis developed in a man aged 75 years. Twelve months of chemotherapy with L-phenylalanine mustard resulted in hematologic remission. Radioautograph of his marrow showed signs of alpha-radiation; whole body counting revealed a significant thorium burden. One year after chemotherapy was stopped, and two years after initial presentation, aleukemic acute granulocytic leukemia led to his death. The role of thorium in the etiology of possibly two successive hematopoietic neoplasms is discussed.

29772 TREATMENT OF THYROID CARCINOMA AS A PROBLEM OF INTERNAL MEDICINE. Roos, J. Amsterdam; Univ. Amsterdam (1975). 149p. (In Dutch).

Thesis.

The usefulness of gallium-67 as a radiopharmaceutical for the detection of carcinoma of the thyroid gland is investigated. Gallium-67 does not accumulate in a benign goitre. In combination with iodide and pertechnetate scintigraphy of the thyroid, the application of gallium-67 is important for the detection of malignancy in large goitres. To increase the efficiency of iodine-131 therapy, a low-iodine diet and intensive diuresis during four days preceding administration of radioactive iodide is recommended. (NL)

Animals

29773 (EUR-5033) RADIOTOXICITY OF TRITIUM IN MAMMALS. Silini, G.; Metalli, P.; Vulpis, G. (Commission of the European Communities, Brussels (Belgium)). Dec 1972. 36p. INIS.

Basic data relative to tritium, its physicochemical behavior in environment, its major sources of contamination and its metabolism through the mammalian organisms are reviewed. After considering the radiotoxicity of tritium particularly at the cellular and whole-body level the conclusion is drawn that the major uncertainties regard the fraction of tritium incorporated into the nuclei of some tissues. This fraction is eliminated very slowly and is capable of modifying the genetic structures of the nucleus. A more refined analysis of radiobiological phenomena and a better knowledge of the dose effect relationship should permit the extrapolation of the data to the low doses of tritium contamination. This extrapolation is of great interest in the field of public health for the elaboration of the relevant radioprotection standards. (INIS)

29774 PRESSING CLINICAL AND EXPERIMENTAL PROBLEMS OF ELECTRICAL CARDIAC STIMULATION. Malinovskii, N. N.; Zubarev, R. P.; Prokhorenko, A. S. (All-Union Scientific Research Inst. of Clinical and Experimental Surgery, Moscow). Khirurgiya (Moscow); No. 5, 64-68(May 1975). (In Russian).

Because of certain disadvantages of ordinary pacemakers, the safety of using a ^{238}Pu powered pacemaker, which has a 10-year life, was determined by inserting such a prosthesis in two dogs. A pacemaker case containing a Tesla coil was inserted in a third dog (control). Observations made for a period of 20 months showed normal blood and biochemistry indexes in the experimental animals. Thus a ^{238}Pu source implanted in the soft tissue of an animal apparently does not produce clinical abnormalities. Microscopical examination of the gonads and hematopoietic organs, muscle, liver, kidneys, adrenals, brain, lungs, and g.i. tract, and skin and lymph nodes showed no adverse effects from the long action of the ^{238}Pu radiation. (JPRS)

29775 HYGIENIC ASPECTS OF STUDIES OF URANIUM LEVELS IN THE ENVIRONMENT AND ITS EFFECT ON THE BODY. Izmerov, N. F.; Elovskaia, L. T. Gig. Sanit.; No. 8, 120-121(1975). (In Russian)

This book represents a continuation of many publications in the 60's and the 70's dealing with the problem of natural radioactivity. In the first two chapters the author summarizes current knowledge about the distribution of uranium in nature and food products, followed by a discussion in Chapter 3 of the manner in which uranium behaves in humans and animals. Chapter 4 covers the manner in which uranium enters the body, its distribution, accumulation and excretion. The effects of uranium on animals in acute experiments are covered in Chapter 5, while Chapter 6 deals with chronic experiments. Chapter 7 deals with the etiology of uranium in low concentrations in various diseases, and Chapter 8 covers hygienic standardization of uranium. On the whole, although one may take exceptions to certain of the author's personal views, this is an encyclopedic achievement which will be of assistance to those interested in natural radioactivity. (JPRS)

29776 OCCURRENCE OF HEMANGIOSARCOMAS IN BEAGLES WITH INTERNALLY DEPOSITED RADIONUCLIDES. Benjamin, S. A.; Hahn, F. F.; Chiffelle, T. L.; Boecker, B. B.; Hobbs, C. H.; Jones, R. K.; McClellan, R. O.; Snipes, M. B. (Lovelace Foundation, Albuquerque, NM). Cancer Res.; 37: No. 7, 1745-1755(Jul 1975).

In a series of related experiments to evaluate the relative toxicity of inhaled radionuclides, beagles were exposed to aerosols containing relatively soluble (chloride) or relatively insoluble (fused clay) forms of ^{144}Ce and ^{90}Sr. With the soluble $^{144}CeCl_3$, significant radiation doses were delivered in the lungs, liver, and skeleton whereas, after $^{90}SrCl_2$ exposure, the radiation dose was delivered predominantly to the skeleton. In dogs exposed to ^{144}Ce and ^{90}Sr in fused clay particles, radiation doses were delivered mostly to the lungs and tracheobronchial lymph nodes. In most dogs dying within 2 years after exposure, deaths were attributable to nonneoplastic radiation-induced lesions in the target organ systems. At later times after exposure, neoplasms were the major cause of death, again occurring mostly in target organs or the adjacent tissues. Lung, liver, and bone-related neoplasms, including five hepatic hemangiosarcomas, developed after $^{144}CeCl_3$ exposure. Among the bone-related sarcomas seen in dogs exposed to $^{144}CeCl_3$ or $^{90}SrCl_2$, the incidence of hemangiosarcomas was over 40 percent. Among the 20 dogs dying with pulmonary neoplasms after exposure to ^{144}Ce or ^{90}Sr in fused clay particles, all had hemangiosarcomas and several also had other neoplasms. This high incidence of hemangiosarcomas has occurred within 7 years after exposure and differs from results in other laboratories where beagles have been exposed to both alpha- and beta-emitting radionuclides. (auth)

29777 REVERSIBLE DIMINUTION OF CONTRACTION BY HEAVY WATER (D_2O) ON PAPILLARY MUSCLE OF THE RAT. Guenther, J.; Pfeiffer, C. (Humboldt-Univ., Berlin). Acta Biol. Med. Ger.; 32: No. 2-3, 279-282(1974). (In German).

The maximal isometric tension, the maximal velocity of tension development, and the calculated relative values of the maximal shortening velocity of the contractile element show a continuous diminution at left papillary muscles of the rat by increasing the content of D_2O in the perfusion medium. All these values reach soon after working 40 min under increasing D_2O concentration 75% of the starting value if the perfusion medium has been rechanged to normal Ringer solution. The findings point to a suppressed contractility rather than to a primary energy lack. (auth)

29778 STUDIES ON THE PROTECTIVE ROLE OF VITAMIN C UNDER CONDITIONS OF EXPOSURE OF THE ORGANISM TO IONIZING RADIATION. Manowska, J. (Jagiellonian Univ., Krakow). Folia Biol. (Krakow); 24: No. 1, 97-145(1976).

The protective action of ascorbic acid against ionizing radiation from an internal source of ^{32}P was studied in frogs, pigeons, and mice, taking into account reactivity of the leukocytic system, cumulation of radioactive phosphorus, body weight, and the weights of the spleen and liver. Assuming that, under the experimental conditions, cumulation of radioactive phosphorus in tissues is a favourable phenomenon, it was found that administration of

vitamin C to animals exposed to radiation from an internal source enhances cellular metabolism. Moreover, ascorbic acid exerts a beneficial action on the haemopoietic system, neutralizing the loss of bone marrow tissue destroyed by ionizing radiation and restoring the percentage composition of the white blood cells to values similar to those observed in the blood of control animals. The action of vitamin C on the organs is selective. Cellular metabolism is enhanced in the organs of some species and depressed in the same organs of other species. The amount of radioactive phosphorus deposited in tissues and the reactivity of haematopoietic tissues to stimulation depend largely on the evolutionary rank of the species under investigation. Ascorbic acid and ionizing radiation evoke opposite reactions in the organism. The findings are discussed in the light of existing hypotheses.

29779 BIOLOGICAL ACTIVITY OF NUCLEAR FISSION PRODUCTS. Nevstrueva, M. A.; Tokina, I. B.; Shubik, V. M. (eds.). Moscow; Atomizdat (1975). 240p. (In Russian).

For the first time the biological activity of an intact mixture of the products of nuclear fission has been reviewed, the products being of different yield, and the combined action of internal and external irradiation of the organisms of experimental animals have been analyzed. A description has been given of the action on complex immunological reactions characterizing the state of nonspecific, specific immunity and autoallergenic reactivity, as well as on the cytomorphologic reactions of the cells of liver, spleen, lymphatic nodes, bone marrow and gut epithelium. The problems of cell and tissue sensitivity and remote results are being discussed. Recommendations are presented on morphological indexes, which could be used for evaluation of the activity of reticuloendothelial and blood forming systems. (JPRS)

Nuclide Kinetics and Toxicology

Man

Refer also to abstract 29198.

29780 (IAEA-R-760F) WHOLE-BODY COUNTER STUDIES OF IRON ABSORPTION IN SUB-TOTAL GASTRECTOMY PATIENTS. Final Report for the Period 1 October 1969-30 September 1971. Runcan, V.; Gheorghescu, B.; Jovin, G.; Suseanu, I.; Vasilescu, F.; Aposteanu, G.; Sparchez, T. (International Atomic Energy Agency, Vienna (Austria)). Jul 1972. 22p. INIS.

6 figs.

The absorption of orally administered iron was investigated in 72 patients having digestive tract abnormalities: 54 with subtotal gastrectomies, 12 with small bowel disease, and 6 with other digestive diseases. The experimental procedure was based upon administration of 8 μCi ^{59}Fe-citrate accompanied by 200 mg iron as ferrous sulfate in tablets to fasting subjects, followed by whole-body counting of retained ^{59}Fe at 3 hours and 10 days. The patients were subjected to a variety of tests, and associations were sought between percentage iron absorption and numerous conditions possibly influencing it. Under the conditions of the examination, and within the statistical significance of the data, the following correlations were found. Iron absorption was not dependent upon sex, type of gastric surgery (i.e., whether duodenum removed or not), type of digestive disease, presence of jejeunal lesions, or anemia. Elevated iron absorption was found to be associated with larger time intervals after surgery, steatorrhea, and shorter intestinal transit times. The results support the hypotheses that depletion of body iron stores directly promotes iron absorption, and that the lower portions of the intestine participate effectively in iron absorption.

29781 (NIOSH-75-171) SOCIOLOGICAL ANALYSIS OF THE REDUCTION OF HAZARDOUS RADIATION IN URANIUM MINES. Pearson, J. S. (Denver Univ., Colo. (USA)). Apr 1975. 137p. Public Health Service, Salt Lake City, UT.

The report describes the responses of companies, unions, and government enforcement agencies to the problem of exceessive radiation in uranium mines resulting in respiratory cancer in Colorado chiefly between the years 1950 and 1969. It focuses on the organizational actions which ultimately solved the hazard as well as the non-technological factors that prevented an earlier solution of the problem.

29782 RADIATION HYGIENIC ASSESSMENT OF THE HAZARD AND PROTECTIONS EFFICACY IN CASE OF AFFECTING EXCORIATIONS AND INTACT CUTANEOUS INTEGUMENT OF MAN BY ^{85}Sr. Ilyin, L. A.; Ivannikov, A. T.; Parfenov, Yu. D.; Konstantinova, T. P.; Popov, B. A.; Stolyarov, V. P. Med. Radiol.; 20: No. 11, 44-49(1975). (In Russian)

In experiments made on 12 examinees, resorption of ^{85}Sr was investigated through intact and injured skin (excoriations) of man. The authors established a higher degree of resorption of ^{85}Sr through excoriations of the skin exceeding its resorption through an intact skin more than 200 times. The assessment of the efficacy of some preparations when cleaning impure cutaneous integument by ^{85}Sr was made. (auth)

29783 INTERNAL CONTAMINATION OF A MAN WITH STRONTIUM 90. Boyadzhiev, A.; Mikhajlov, M. A.; Jotov, M.; Novakova, E.; Kerteva, A. (Nauchno-Izsledovatelski Inst. po Radiologiya i Radiatsionna Khigiena, Sofia (Bulgaria)). Rentgenol. Radiol.; 14: No. 2, 130-134(1975). (In Bulgarian).

A case of contamination with strontium 90 through carelessness is reported. The attempt for analysis was made on the basis of the urinary strontium excretion. The urine elimination equation was determined and from here the elimination function R(t) (unloading function) conforming to the affected individual. The amount of urinary excreted strontium 90 during the first 184 days was determined. The content of strontium 90 in the organism at a given moment was estimated with aid of the unloading function as well as by use of an empiric formula taken for comparison from the literature. The dose of internal radiation of the affected individual was estimated for the first 184 days and for 50 years. The hazard was evaluated by comparing the data obtained with the recommendations of ICRP. (auth)

29784 CADMIUM—A HEALTH HAZARD IN THE HUMAN ENVIRONMENT. Cumbrowski, J.; Raffke, W. (Humboldt-Universitaet, Berlin (German Democratic Republic). Hygiene-Institut). Z. Gesamte Hyg. Ihre Grenzgeb.; 21: No. 1, 1-7(Jan 1975). (In German).

The present contribution is a bibliographical review of the heavy metal cadmium. Its natural resources are mentioned along with its use in the general production process and potential sources of human cadmium contamination. It further gives an idea of the spectrum of toxicologic effects produced by cadmium in the human organism. Finally, it mentions international cadmium tolerance standards published so far and recommendations on how to prevent chronic cadmium damages as well as currently used methods of detecting cadmium in air, in water and human food.

29785 A STUDY OF THE DISPERSITY OF Pu^{239} PARTICLES IN CONTACT CONTAMINATION OF THE SKIN. Khodyreva, M. A.; Egorova, M. S.; Sit'ko, R. Ya.; Vostrukhov, E. I.; Musatkov, B. F. Gig. Sanit.; No. 5, 50-53(May 1975). (In Russian).

For English translation see the journal Hyg. Sanit.

29786 ENVIRONMENTAL IMPACTS OF HIGH LEVEL RADIOACTIVE WASTE DISPOSAL. Cohen, B. L. (Univ. of Pittsburgh). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 56-59(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The potential hazards of the high level waste produced by one year of all nuclear power in the U.S. are calculated as a function of time for direct gamma radiation, inhalation, and ingestion, and scales are given for consequences of the worst credible handling. The probability for buried waste to be released into the environment by several pathways is estimated, and several factors of related interest are discussed. (auth)

29787 COMPARISON OF VARIOUS TREATMENT SCHEDULES FOR ACCELERATING THE ELIMINATION OF RADIOIODINE FROM THE THYROID AND THE HUMAN BODY. Livadas, D. P.; Koutras, D. A.; Sfontouris, J.; Pharmakiotis, A. D.; Malamos, B. (Athens Univ. (Greece). Dept. of Clinical Therapeutics). Nucl.-Med.; 14: No. 3, 219-227(Aug 1975).

In 68 euthyroid patients undergoing ^{131}I thyroid function tests the thyroidal, urinary and plasma protein-bound radioactivity has been serially measured for 14 days. The patients were subdivided in controls and nine groups treated with potassium iodide, carbimazole, potassium perchlorate and TSH, single or in combination. The aim was to devise a treatment scheme for accelerating the release of iodine from the thyroid and the elimination from the body in cases of accidental radioiodine poisoning if the patient is seen after the radioiodine has already been taken up by the gland. All treatment schedules were effective, but TSH injections gave the best results, especially if combined with carbimazole and potassium perchlorate. This combination is the treatment of choice under these circumstances. (DE)

Animals

Refer also to abstracts 29100, 29108, 29123, 29151, 29179, and 29775.

29788 (CEA-N-1818) IN SITU, MEASUREMENTS ON PLUTONIUM CONCENTRATION, IN VEGETAL AND ANIMAL MARINE

SPECIES AS A FUNCTION OF THEIR PHYLOGENETIC POSITION. Fraizier, A.; Guary, J.-C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Oct 1975. 19p. (In French). INIS.

The accumulation of plutonium by 31 vegetal and animal marine species belonging to a large number of phyla was demonstrated in a reference coastal site. Fixation levels ranging from 171.6pCi/kg fresh weight for a lichen to 0.04pCi/k fresh weight for a fish showed that the retention of the radionuclide by the organisms studied was related to their phylogenetic position. Biological indicators especially suitable for monitoring coastal plutonium radioactivity have been identified. (FR)

29789 COMPARATIVE INVESTIGATIONS OF OSTEOTROPIC ISOTOPES. Pt. 1. Animal Experiments on the Utake of ^{18}F, ^{85}Sr, AND ^{99m}Tc-EHDP. Creutzig, H.; Creutzig, A.; Gerdts, K. G.; Eckhardt, W. (Medizinische Hochschule Hannover (F. R. Germany). Inst. fuer Nuklearmedizin und Spezielle Biophysik); Greif, E. (Medizinische Hochschule Hannover (F. R. Germany). Unfallchirurgische Klinik). Fortschr. Geb. Roentgenstr. Nuklearmed.; 123: No. 2, 137-143(Aug 1975). (In German)

6 figs.; 3 tabs.; 28 refs. Part of the thesis by A. Creutzig and K. G. Gerdts.

In normal rabbit bones, as well as in callus, there is significantly more uptake of ^{18}F than of ^{85}Sr or ^{99m}Tc-EHDP. Extraosseous abscesses show significantly higher uptake of ^{99m}Tc than of ^{18}F or ^{85}Sr. In the presence of hyperaemia, there is no significant difference in the uptake of the various osteotropic radionuclides. (DE)

29790 THE DIFFERENCES IN THE DISTRIBUTION OF RADIOACTIVE BERYLLIUM CHLORIDE CARRIER-FREE OR WITH A CARRIER IN THE BODY OF RATS IN CASE OF INTRATRACHEAL ADMINISTRATION. Kuznetsov, A. V.; Matveev, O. G.; Suntsov, G. D. Gig. Sanit.; No. 10, 113-114(Oct 1974). (In Russian)

For English translation see the journal Hyg. and Sanit.

Radioactive Be with carrier (10 μCi of ^{7}Be + 1 mg of stable $BeCl_2$ per rat) or carrier-free (10 μCi of ^{7}Be) (0.3 ml vol.) was given intratracheally to rats anesthetized with ether. The animals were subsequently decapitated on different days, and the γ radiation of organs and tissues measured and compared with a standard. With a single administration of the maximum permissible dose (1 mg/kg), the isotope was retained for a long time (biological half-life of about 20 days). When carrier-free 7 $BeCl_2$ was similarly administered, the biological half-life was 1 day. In the lung retention, most of the material remained in the lungs or was deposited in the bone. (tr-auth)

29791 IMPROVED METHOD OF FISSION-FRAGMENT RADIOGRAPHY OF PLUTONIUM IN RAT BONE. Storr, M. C. (National Research Council of Canada, Ottawa); Hollins, J. G.; Clarke, R. L. Int. J. Appl. Radiat. Isot.; 26: No. 12, 708-713 (1975).

A technique is described in which the high sensitivity of fission-fragment radiography is combined with a histological image of the bone. Undecalcified bones, saturated with stabilized, monomeric methacrylates were irradiated with γ rays to provide blocks of embedded bone of uniform and consistent hardness. Sections of bone were mounted on quartz slides and covered with a polycarbonate film to record fission-fragment tracks produced by irradiation of the sandwich with thermal neutrons. Before etching a polycarbonate film to render visible the tracks, the sandwich was separated to preserve the bone section and permit the subsequent recombination in a comparison microscope of the images of the bone section and its tracks. An analysis of these fission-fragment radiographs in 15 μm bands is presented. It is used to describe the distribution of plutonium about the bone surface of vertebral trabeculae from mature rats at times up to one year after intravenous injection of plutonium citrate. (auth)

29792 EFFECT OF TEMPERATURE ON THE UPTAKE AND RETENTION OF ^{60}Co AND ^{65}Zn BY THE COMMON SHRIMP CRANGON CRANGON (L.). van Weers, A. W. (Reactor Centrum Nederland, Petten). pp 35-49 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical, and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

The effect of temperature on the uptake of ^{60}Co and ^{65}Zn directly from seawater and on the retention after uptake from labelled food by the common shrimp Crangon crangon (L.) was studied. The mean concentration factor reached in whole shrimps after 16 to 21 days uptake from seawater ranges from 6 to 10 and from 30 to 60 for ^{60}Co and ^{65}Zn, respectively. The effect of temperature on the uptake from seawater is small for both radionuclides. From the loss of ^{60}Co and ^{65}Zn, observed when shrimps moulted, it appears that a large fraction of the radionuclides taken up from seawater is bound by the exoskeleton. Moulting frequency and the rate of food uptake increase with temperature. Both radionuclides are assimilated from labelled food and are retained according to a two-compartmental model. A temperature increase of 10°C reduces the biological half-lives of the long-lived component in the retention of ^{60}Co and ^{65}Zn with a factor of about two. It is concluded that shrimps with accumulate ^{60}Co and ^{65}Zn mainly through the food chain. An increase in temperature will result in a higher rate of uptake of the radionuclides with food and in a shorter biological half-life. Consequently the equilibrium concentration factor will be reached sooner. (auth)

29793 INFLUENCE OF TEMPERATURE ON THE CONTAMINATION OF MARINE SPECIES BY IRON-59. Fraizier, A.; Ancellin, J. (CEA, Cherbourg, France). pp 51-66 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975). (In French)

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

Interactions between a marine mollusc and fish (Mytilus edulis, Biennius pholis) and iron-59 were investigated in relation to the radionuclide in marine water and to the environmental temperature. It appeared that contamination is dependent on temperature; this factor partly influences the physiochemical state of the radionuclide and the metabolic activity of species. (auth)

29794 CYCLING OF ^{55}Fe AND ^{65}Zn IN COLUMBIA RIVER CARP FOLLOWING REACTOR SHUTDOWN. Jones, W. M. (Oregon Coll. of Education, Monmouth); Jennings, C. D.; Cutshall, N. H. pp 309-318 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975).

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

The decline of ^{55}Fe and ^{65}Zn has been observed in the tissues of Columbia River carp following shutdown of the plutonium production reactors at Hanford, Washington. A model for the decrease in specific activity (activity per gram total element) is tested for carp flesh. The predictions of the model are slightly higher than the specific activities observed, probably because of stable element dilution. Rate of loss of ^{65}Zn appears to follow the order skin > flesh > liver, eggs > heart, while the rate of loss of ^{55}Fe follows the order heart > eggs > flesh > liver, underscoring the fact that each tissue may treat each element in a characteristic manner. Therefore the ability of an organism to free itself of radionuclide contamination will depend on what portion of the organism and what radionuclide is involved. (auth)

29795 EFFECT OF ACCLIMATION TEMPERATURE ON PROLIFERATION OF ERYTHROPOIETIC PRECURSORS IN CARASSIUS AURATUS AND ON THE UPTAKE OF TRITIATED THYMIDINE IN HAEMATOPOIETIC AND INTESTINAL TISSUE. Nieto Garcia, M.; Bengoechea Pere, M. J.; Maganto Fernandez, J. G. (Junta Energia Nuclear, Madrid). pp 319-327 of Combined Effects of Radioactive, Chemical, and Thermal Releases to the Environment. Vienna; International Atomic Energy Agency (1975). (In Spanish)

From symposium on the combined effects of radioactive, chemical and thermal releases to the environment; Stockholm, Sweden (2 Jun 1975). See STI/PUB-404; CONF-7506117-.

The authors studied the cellular proliferation of undifferentiated erythropoietic precursors in the goldfish Carassius auratus acclimated at various temperatures: 5, 10, 20, 30 and 35°C. The combined use of high-resolution autoradiography and DNA labelling with ^{3}H-TdR made it possible to study the duration of the cellular cycle from the decrease in the number of grains/nucleus with time. A shortening of the mitotic cycle was found for high acclimation temperatures, together with an increase in the labelled cell fraction and in the number of grains/nucleus in the four erythropoietic cellular precursors. The authors also studied the uptake of ^{3}H-TdR in intestinal and haematopoietic tissue, observing increased uptake in the haematopoietic tissue with temperature over the range considered, and a decrease in uptake by the intestine between 25 and 35°C. The number of cells per gram of fish decreases at high acclimation temperatures. (auth)

29796 EARLY CADMIUM-INDUCED CHANGES OF THE PERMEABILITY OF TESTICULAR BLOOD VESSELS TO ^{131}I ALBUMIN IN THE RAT. Barowicz, T.; Jastrzebski, M.; Wojcik, K. Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 22: No. 2, 201-204 (1974).

Male rats were treated with intraperitoneal injection of 0.04 mM/kg cadmium chloride ($CdCl_2$). At 4 to 6 h post injection an increase of testis ^{131}I albumin uptake was found. The differences at 6 h after injection were significant ($P < 0.05$). An increased testicular uptake was accompanied by a decreased radioactivity of blood plasma. The results suggested that cadmium chloride disturbs the permeability of the walls of the testicular blood vessels to albumin. (auth)

29797 KINETICS OF D_2O INTAKE IN THE STRIATED MUSCLE. Visilescu, V.; Katona, E.; Margineanu, D. G. (Inst. of Medicine and Pharmacy, Bucharest). Stud. Biophys.; 52: No. 3, 223-227(1975).

This paper presents a kinetical analysis of the H_2O-D_2O exchange in frog striated muscle. The exchange was investigated by infrared spectroscopy at $\lambda \approx 1470$ nm and the time-course of the process analyzed by numerical fitting of experimental data. The rate parameters obtained in terms of a first-order kinetics show that the deuteration of the muscle is a rather slow process, the semi-saturation times being ~20 min, and the saturation times reaching more than 90 min, at 20°C. (auth)

Plants

Refer also to abstracts 29105, 29119, and 29150.

29798 (IAEA-R-1186F) UPTAKE OF FISSION PRODUCTS BY CERTAIN VEGETABLE CROPS. Part of a Coordinated Programme of Isotopic Tracer Aided Studies on the Origin and Fate of Foreign Chemical Residues in the Agricultural Environment. Final Report for the Period 15 September 1972-14 September 1974. Pablo, F. E. (International Atomic Energy Agency, Vienna (Austria)). Nov 1974. vp. INIS.

Of the long-lived fission products strontium and caesium are considered the major hazards to the consumers of agricultural products. Experiments were made on the uptake and translocation of ^{89}Sr and ^{137}Cs in vegetables under local conditions: potato vine, tara plant, pepper, eggplant, and jute. The radioactive isotopes were mixed with the nutrient solution in two concentrations: 50 μCi and 0.1 μCi of ^{89}Sr as $SrCl_2$ (18 mCi/g Sr) and ^{137}Cs in 1N HCl (22 Ci/g Cs) per liter of nutrient solution and administered to foliar or to the roots. The lower concentration was designed to simulate fallout conditions. The lower dose (0.1 μ Ci/l/plant) 1.9 to 3.4% of ^{137}Cs and 1.7 to 2.9% of ^{89}Sr were absorbed after foliar application and less than 1% after root application. At the higher dose (50 μCi/l/plant) absorption was higher and differed according to the radioisotope and plant species. The maximum uptake of ^{137}Cs and ^{89}Sr in different plant species after foliar application followed the same order: eggplant 67 and 9.2% respectively, pepper 42 and 4.5%, jute 36 and 3.9%, potato vine 36 and 3.9%, taro 4.6 and 1.7%. Rainfall reduced absorption after foliar application of ^{137}Cs and ^{89}Sr by 80-90%. Root uptake was high from nutrient solution (up to 99% and 96% respectively in potato vine, and 37 and 75% in eggplant, 75 and 76% in pepper) but very low, not exceeding 2% of ^{137}Cs and 8% of ^{89}Sr from the soil, which, of course, is much more important for real risk in the field conditions. Translocation of ^{137}Cs and ^{89}Sr after foliar or root application was demonstrated by autoradiography except for taro plants for which there was no evidence of translocation. (INIS)

29799 PROCEDURE OF PREPARING A FUNGAL MYCELIUM FOR METAL RETENTION. Stamberg, K.; Stamberg, J.; Katzer, J.; Prochazka, H.; Jilek, R.; Nemec, P.; Hulak, P. (to Ceskoslovenska Komise pro Atomovou Energii, Prague). German (FRG) Patent 105085/D/. 5 Apr 1974. 4p. (In German)

German Democratic Republic Cl. 21g21/33.

Patent describing procedures for solidifying mycelia of particular fungi intended for use in industrial retention of metals (e.g. uranium, radium, lead) from solutions. The natural or dried mycelia are mixed with polymerizable or polycondensable components. Solidified products are formed and further treated by granulation, screening, or pressing. (INIS)

29800 ACCUMULATION OF ^{90}Sr BY HERBACEOUS PLANTS IN A BIRCH FOREST. Smirnov, E. G.; Tikhomirov, F. A. (Moscow State Univ.). Sov. J. Ecol. (Engl. Transl.); 6: No. 2, 102-106(1975).

Translated from Ekologiya; 6: No. 2, 16-22(1975).

We studied the accumulation of ^{90}Sr by 80 species of herbaceous plants between 8 and 11 years after application of this radionuclide to the surface of the forest-floor litter in a birch wood. The range of interspecies differences in ^{90}Sr accumulation was about 70-fold in absolute units and 110-fold in strontium units. These differences were due to coordination of the mineral nutrition of individual species of herbaceous plants forming consistent associations with different soil horizons having different ^{90}Sr contents. (auth)

29801 LIQUID SCINTILLATION COUNTING OF CARBON-14 IN ALGAE. Dodakundi, G. B.; Rodgi, S. S. (Karnatak Univ., Dharwar (India). Dept. of Zoology). J. Karnatak Univ. Sci.; 19: 37-41(1974).

Experiments were carried out using sterilized mineral medium (pH 8.8), autoclaved sewage (pH 8.8) and raw sewage (pH 7.1). One set of these media was inoculated with a species of Scenedesmus and the second set devoid of alga served as a control. Radioactive sodium bicarbonate ($NaH^{14}CO_3$) was added to both the sets. To study the radioactive incorporation in algal cells, direct centrifuging of algal suspension instead of passing through the millipore filter was employed. Addition of 0.2 ml of 10% ethanolamine to 5 ml of scintillation solution seemed to stabilize the percent recovery sodium bicarbonate is discussed. The recovery was satisfactory in media with pH 8.8, while lower recovery was noticed in raw sewage probably due to lower pH (7.1). The limitations of the method are also outlined. (auth)

29802 A CHEMICAL STUDY ON THE OCCURRENCE OF RARE EARTHS IN PLANTS. Yliruokanen, I. Ann. Acad. Sci. Fenn., Ser. A II; No. 176, 1-28(1975).

The content of rare earths in different plants and in a standard plant material (N. B. S. Standard orchard leaves) has been determined using spark source mass spectrometry with electrical detection. A comprehensive literature review with 65 references is included. (auth)

New Tracer Techniques

Refer also to abstracts 28589, 29207, 29216, 29264-29270, 29272-29275, 29277, 29278, and 29791.

29803 (AED-CONF-75-193-118) PRINCIPLES AND DEVELOPMENT OF THE RADIOIMMUNOASSAY. Schwartz, U. (Freie Univ. Berlin (F.R. Germany). Klinikum Steglitz). 1975. 4p. (In German). INIS.

From 56th meeting of the Deutsche Roentgengesellschaft-Gesellschaft fuer Medizinische Radiologie, Strahlenbiologie und Nuklearmedizin e.V. (Deutscher Roentgen-Kongress); Berlin, F. R. Germany (1 May 1975).

Compared to conventional biological test methods as well as to purely physiocochemical methods, the radioimmunoassay exhibits higher sensitivity, higher selectivity, and better practicability. It has thus become possible to determine many substances in the nano- and picogramme region. It should, however, be pointed out that for an efficient use of radioimmunological test methods, their indications and limitations should be studied critically, and their reliability and quality should receive constant supervision. (DE)

29804 (AED-CONF-75-408-003) DOUBLE NUCLIDE EXAMINATIONS IN TUMOUR DIAGNOSTICS. Rey, G.; Kunstein, W.; Schmidt, W.; Untucht, H. J. (Katharinenhospital, Stuttgart (F.R. Germany). Strahlenklinik). 1975. 9p. (In German). INIS.

From annual meeting of the Hessische Gesellschaft fuer Medizinische Strahlenkunde and the Vereinigung Suedwestdeutscher Radiologen und Nuklearmediziner; Marburg, F.R. Germany (20 Sep 1975).

27 refs. With abstract.

In recent years, a considerable step further has been made regarding the efforts for a correct tumour diagnosis and a suitable therapy. By means of the double to treble nuclide examination, it is possible to prematurely detect possible metastasis which must be treated according to the particular case. Furthermore, an exact irradiation plan is possible. On the other hand, some patients are spared the test of a curative radiotherapy which is not always well tolerated. (DE)

29805 (AED-CONF-75-482-003) CONTROL OF THE THERAPY AND COURSE OF LUPUS ERYTHEMATODES BY RADIOIMMUNOLOGICAL DETERMINATION OF THE ANTI-DNA ANTIBODIES. Schaeben, B.; Helmke, K.; Federlin, K. 1975. 6p. (In German). INIS.

From 7th meeting of the Gesellschaft fuer Immunologie; Mainz, F.R. Germany (9 Oct 1975).

Available from ZAED.

Anti-DNA antibodies play an important part in the pathogenesis of LED. The determination of these antibodies is not only important for diagnosis and differential diagnosis but the control of the antibody titre is also a good parameter for observations of the course of the disease and for therapy control. Of the methods available, the Farr technique appears to be more suitable for clinical routine than the double antibody method which offers new possibilities in the investigation of LED immunopathology. (DE)

29806 (CONF-760119-2) EARLY PROGRESS OF THE BIOMEDICAL COMPUTING TECHNOLOGY INFORMATION

CENTER (BCTIC). Maskewitz, B. F.; Henne, R. L.; McClain, W. J. (Oak Ridge National Lab., Tenn. (USA)). 1976. 10p. Dep. NTIS $3.50.

From sixth symposium on the sharing of computer programs and technology in nuclear medicine; Atlanta, Georgia, United States of America (USA) (26 Jan 1976).

Through five years of effort by the Society of Nuclear Medicine Computer Committee, the Biomedical Computing Technology Information Center (BCTIC) was established by the Division of Biomedical and Environmental Research (DBER) of the U. S. Energy Research and Development Administration (ERDA) at the Oak Ridge National Laboratory in July of 1975. BCTIC forged ahead into the tasks of designing guidelines and procedures, acquisition and packaging of computer codes, data, and interface designs; building a bibliographic data base; and maintaining a directory of the user community. Important contacts were made with societies and individuals involved in biomedical computing; and BCTIC was publicized through news releases, the BCTIC newsletter (bimonthly, since October, 1975), presentations at meetings, and personal contacts. This paper presents the response BCTIC has received in its initial months, gives a progress report on the developmental phase, and takes a look to the future of BCTIC as a national technology resource in nuclear medicine computing. (auth)

29807 (IAEA-R-803F) RESEARCH WITHIN THE COORDINATED PROGRAMME ON THE USE OF ISOTOPES IN RICE PRODUCTION STUDIES. Final Report for the Period 1 November 1969-30 November 1974. Abdullah, N. (International Atomic Energy Agency, Vienna (Austria)). Jan 1975. 11p. INIS. 10 tabs.

From 1970 to 1973 the effect of selected water management practices on fertilizer-nitrogen utilization by IR 22 rice plant from urea and ammonium sulfate was studied during the dry season. During the wet season, the effect of a mid-term drainage on the efficiency of N-utilization and grain yield of IR 22 and Dewi Ratih rice varieties were investigated. From 1971 to 1972 experiments were carried out to determine the best method for basal application of N, the efficiency of fertilizer-N utilization, the effect on protein content, and on quality as well as grain yield of fertilizer applied at various physiological stages of growth in both the wet and the dry season. From 1972 to 1973 the optimum time of N application and its effect on yield components and on the distribution of absorbed fertilizer-N in the rice plants were studied, and the following year the effect of the time application on the rate of N uptake and its distribution in the plant. Summaries of results are given as tables. (INIS)

29808 (IAEA-R-1180F) RADIOISOTOPIC STUDIES ON THE PHAGOCYTIC ACTIVITY OF GUINEA PIG MACROPHAGES AS A METHOD FOR THE EVALUATION OF BRUCELLA VACCINES. Final Report for the Period 1 July 1972-30 June 1973. Ugalde, R. A.; Vigliocco, A. M. (International Atomic Energy Agency, Vienna (Austria)). Aug 1974. 10p. (In Spanish). INIS.

It has been shown experimentally that the routine test used to quantify the potency of antibrucellosis vaccines enables vaccines with low immunogenic ability to be considered efficient. Experimental tests were proposed for improving the routine test based on increasing the number of challenge bacteria or on reducing the vaccination dose. This study investigates the possibility of determining new variables for the immune state to see whether they might be introduced as parameters for evaluating the immunological potency of antibrucellosis vaccine. The tests involve challenging vaccinated guinea pigs with ^{131}I-labelled Brucella cells and determining the amount phagocytized in the liver and spleen. The statistical analysis of the variation with dose of vaccine shows that the variables validly indicate a variation with dose and a significant difference from the unvaccinated controls. The responses, while curvilinear, could be fitted with a fairly simple hyperbolic function which later showed a good predictive value in indicating degree of protection to a challenge dose. The test of immune sera suggested that its action applies basically to the activity of the liver. The activity of the spleen does not seem to be altered by immune serum since the specific activity of the spleen in normal animals plus serum was the same as that observed in normal animals alone. Overall analysis of the responses obtained suggests that the proposed variables (% of Dose/gm of liver), (% of Dose/gm of spleen) and (cpm/gm of liver show/cpm/gm of spleen) behavior with respect to the vaccination doses and the degree of protection similar to that shown by other studies. The results suggest a clear need for an exhaustive study of the proposed variables over the vaccination dose range of 10^2-10^4 organism/animal.

29809 MICROBIAL PROTEIN SYNTHESIS IN RELATION TO AMINO-ACID REQUIREMENTS. Annison, E. F. (Unilever Research Lab., Bedford (UK)). pp 141-152 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

The factors that influence the supply of essential amino acids to ruminant tissues have been discussed in relation to amino-acid requirements. Factorial analysis showed that rumen microbial protein meets most of the calculated requirements. The remainder is met in most circumstances by dietary protein that escapes ruminal degradation: the latter is largely determined by the solubility of the protein, and the level of food intake. Evaluation of present data on pathways of amino-acid synthesis in the rumen suggest that although there is considerably amino-transferase activity, attempts to confirm the control role of glutamic and aspartic acids by $^{26}NH_3$ incorporation studies have as yet been inconclusive. The limited data available suggest that the optimal level of rumen ammonia for microbial cell synthesis when energy is not limiting may be as low as 8 mg/100 ml. Methods of assessing amino-acid requirements by procedures based on plasma amino-acid responses, or by changes in the metabolism of amino acids when supplied in excess of requirement and detected by the excretion of $^{14}CO_2$ or urinary ^{26}S, have been shown to be valid, but intrinsically too complex for general use. (auth)

29810 ISOTOPE PROFILE INVESTIGATIONS FOR THE DETECTION OF VENOUS THROMBOSIS IN THE LEGS WITH THE USE OF ^{131}I-MAA. Pertynski, T.; Oginski, M.; Olejnik, J.; Surma, M. (Akademia Medyczna, Lodz (Poland). Osrodek Naukowo Badawezy; Szpital MSW, Lodz (Poland). Dept. of Vascular Surgery). Nucl.-Med.; 14: No. 3, 248-252(Aug 1975).

1 fig.; 1 tab.; 17 refs.

Twenty patients were tested with an isotope profile method for the detection of venous thrombosis in the leg. Iodine-131-labeled MAA was introduced into the dorsal vein of the foot. The results of the test agreed with the results of phlebography. The authors stress the simplicity and accuracy of the above method. (DE)

29811 LIVER SCANNING IN DIFFUSE LIVER DISEASE. Aiginger, P.; Atefie, K.; Scherak, O.; Wolf, A.; Hoefer, R.; Seyfried, H. (Vienna Univ. (Austria). 2. Medizinische Klinik). Fortschr. Geb. Roentgenstr. Nuclearmed.; 123: No. 2, 121-125 (Aug 1975). (In German)

7 figs.; 2 tabs.; 15 refs.

The results of liver scans performed with ^{99m}Tc-sulphur colloid in 169 patients suffering from diffuse liver disease and in 48 normal controls were evaluated. The patients with reactive hepatitis, acute hepatitis, chronic persistent hepatitis, fatty liver, and fibrosis of the liver show only minimal deviations from the scintigraphic pattern. On the contrary, highly increased colloid uptake in the spleen is found in cases of chronic aggressive hepatitis, whilst the intrahepatic distribution of the colloid is approximately normal. In cases of liver cirrhosis, increased colloid uptake is found in the left lobe of the liver as well as in the spleen and in the bone marrow. Either normal findings or cirrhosis-like changes of the colloid distribution are observed in patients with alcoholic hepatitis. (DE)

29812 ON THE STABILITY OF A TIN-PHYTATE COMPLEX. Sewatkar, A. B.; Noronha, O. P. D.; Ganatra, R. D. (Bhabha Atomic Research Centre, Bombay (India). Radiation Medicine Centre; Tata Memorial Hospital, Bombay (India)). Nucl.-Med.; 14: No. 3, 293-297(Aug 1975).

1 fig.; 1 tab.; 3 refs.

The stability of tin-phytate solution stored at room temperature has been studied. It was found that there is a pronounced increase in the rate of degradation of this complex, both temperature and phase change contributing to the enhanced rate of decomposition. The kidney uptake which is occasionally observed clinically with an aged tin-phytate complex labelled with ^{99m}Tc is probably due to an intermediate product which subsequently breaks down on further storage. Lyophilized tin-phytate complex kits have a longer shelf life than the aqueous complex. (DE)

29813 DETERMINATION OF THE REGIONAL VENTILATION-PERFUSION RATIO BY MEANS OF XENON-133. Imhof, H. (Vienna Univ. (Austria). 1. Medizinische Klinik); Schlick, W. (Vienna Univ. (Austria). 2. Chirurgische Klinik). Nucl.-Med.; 14: No. 3, 232-239(Aug 1975). (In German)

5 figs.; 18 refs.

Knowledge of the regional ventilation/perfusion ratio is of great interest for the diagnosis and therapy of disorders of pul-

monary function. By injecting intravenously a bolus of Xe-133 during breathholding and by recording the influx of activity into the lung with a scintillation camera and analogue tape storage, the regional perfusion of the lungs can be determined, using the count-rate increase per unit time. Once the maximum count-rate is reached the patient is allowed to breath normally. The slope of the count-rate decrease over the lungs is a measure of ventilation. The regional ventilation/perfusion ratio is calculated by dividing these two indices. Regional disturbances of the ratio are the most frequent cause of hypoxia. The demonstration of such disturbances are therefore of significance in the diagnosis and therapeutic control of pulmonary diseases. (DE)

29814 THE PHARMACO-KINETICS OF ANGIOGRAPHIC CONTRAST MEDIA WITH SPECIAL REFERENCE TO THE EXTRAVASCULAR SPACES. Fundamental Studies on Dogs for the Characterization of Angiographic Media. Pt. 1. The Pharmaco-Kinetics of Various Contrast Media Under Conditions of Constant Infusion (Balanced Flow). Lagemann, K. (Tuebingen Univ. (F. R. Germany). Medizinisches Strahleninstitut und Roentgenabteilung). Fortschr. Geb. Roentgenstr. Nuklearmed.; 123: No. 3, 247-252(Sep 1975). (In German)

2 figs.; 5 tabs.

The pharmaco-kinetics of angiographic contrast media in the extra-vascular space, which are largely unknown, were investigated experimentally in dogs. As part of a basic study, using radio-active contrast media, it was possible to determine the concentration and rate of elimination in practically all organs and tissues. Measurements were carried out first after prolonged infusion of contrast under conditions of balanced flow, and secondly six hours after the end of the infusion. It was therefore possible to determine the inflow and loss of contrast medium in various organs, or organs systems. The most commonly used angiographic contrast media in Germany were investigated. Their kinetic behavior is largely identical, their pattern of distribution and elimination depended principally on the organ or tissue. (DE)

29815 SEQUENTIAL SCINTIGRAPHY OF FOUR DIFFERENT ^{99m}Tc HUMAN ALBUMIN PREPARATIONS USED FOR LUNG SCANNING. Eissner, D.; Hahn, K.; Wolf, R.; Brod, K. H.; Grimm, W.; Gechter, M. (Mainz Univ. (F. R. Germany). Inst. fuer Klinische Strahlenkunde). Fortschr. Geb. Roentgenstr. Nuklearmed.; 123: No. 3, 206-209(Sep 1975). (In German).

4 figs.; 2 tabs.; 13 refs.

The biological behavior of four ^{99m}Tc-marked human albumin preparations, prepared by different methods, was studied by serial scintigraphy and excretion measurements. Three preparations consisted of particles of irregular albumin macroaggregates, the fourth was in the form of spherical albumin particles (microspheres). Forty-five patients with various pulmonary abnormalities were examined. The following parameters were used for comparison: half-life of pulmonary activity, changes in activity in liver and spleen as a measure for the formation of Tc-containing particle fragments, uptake in the thyroid and stomach and urinary excretion as an indication of the stability of the nucleid fixation. Despite marked differences in their biological behavior, all four substances provide comparable information and lack of toxicity and are suitable for lung scintigraphy. Because of the rapid initial decline in activity in the lung, microspheres are more suitable for use with a gamma camera, whereas the other three preparations, in view of their long persistence in the lung can be conveniently used for the slower examinations with a conventional scanner. (DE)

29816 MYOCARDIAL BLOOD FLOW IN PATIENTS WITH CORONARY DISEASE WHILE IN ACTIVE EMPLOYMENT. Kahn, P.; Heeger, H.; Aldor, E. (Hanuschkrankenhaus, Vienna (Austria). Nuklearmedizinisches Inst.; Hanuschkrankenhaus, Vienna (Austria). 2. Medizinische Abt.). Nucl.-Med.; 14: No. 3, 228-231(Aug 1975). (In German)

1 tab.; 4 refs.

In the course of coronary angiographies the blood flow of the right and the left coronary artery was determined by the ^{133}Xe lavage method in 89 patients with coronary heart disease. There was a statistically significant difference between the flow values of the LCA and RCA, while there was none between the blood flow values of blue- and white-collar workers suffering from coronary artery disease. Also a significantly better blood circulation of the right as well as of the left coronary artery was found in female employees in comparison to male employees. (DE)

29817 PROTOKOLLIERUNG BEI DER MEDIZINISCHEN ANWENDUNG IONISIERENDER STRAHLEN. Diagnostik und Therapie mit Offenen Radioaktiven Praeparaten. (Recording on Medical Application of Ionizing Radiations. Diagnosis and Therapy by Means of Unsealed Radioactive Preparations). Berlin, F. R. Germany; Beuth (Aug 1975). 4p. (In German). (DIN-6827(pt.2)).

Recording means to list the relevant data on medical application of unsealed radioactive preparations (diagnosis and therapy), especially (a) the physical and chemical properties of the radioactive materials used, (b) the data relevant to the determination of the individual radiation dose. (DE)

29818 INDIUM (^{111}In)-LABELLED BLEOMYCIN FOR THE DETECTION OF INTRACRANIAL LESIONS. Merrick, M. V.; Lavender, J. P. (Royal Postgraduate Medical School, London (UK). Dept. of Radiodiagnosis); Chaucer, B.; Walter, L. H. (Royal Postgraduate Medical School, London (UK). Dept. of Radiotherapy); Clay, B. (Middlesex Hospital, London (UK). X-Ray Dept.); McCready, V. R. (Royal Marsden Hospital, Sutton (UK). Dept. of Nuclear Medicine); Thakur, M. L. (Hammersmith Hospital, London (UK). M.R.C. Cyclotron Unit). Nucl.-Med.; 14: No. 3, 263-271(Aug 1975).

6 figs.; 1 tab.; 6 refs.

Brain scans with ^{99m}Tc-pertechnetate were compared with scans made after administration of ^{111}Indium bleomycin in 38 patients scanned on 41 occasions. They gave similar results in 34 pairs of examinations, including cases in which both failed to detect the tumor. In seven cases, the two agents differed. In two of these bleomycin distinguished residual tumor from the effects of craniotomy more clearly than did pertechnetate; in three bleomycin apparently detected tumor not seen with pertechnetate, and in two the differences may have been due to technical factors, or are unexplained. (DE)

29819 UREA-^{15}N CONVERSION AFTER INTRAVENOUS ADMINISTRATION IN SHEEP. Boda, K.; Havassy, I. (Slovenska Akademia Vied, Kosice (Czechoslovakia). Ustav Fyziologie Hospodarskych Zvierat). pp 99-109 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Coordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

After intravenous administration of ^{15}N-labelled urea in sheep fed a low nitrogen diet (7.6 g N/d) and a higher nitrogen diet (24 g N/d, 42% urea-N) it was found that for both diets, the largest part of ^{15}N unretained (24-56%) is excreted in urine within 24 hours. On the following days only small amounts (1.2-4.2%) of ^{15}N are excreted. On the 3rd-9th day, ^{15}N excretion decreases. ^{15}N excretion into the digestive tract in the first 24 hours was low in comparison with that excreted in the urine, less than 1% of the administered dose. ^{15}N not excreted in the urine is thought to have been utilized in the nitrogen pool of the sheep during the 9 days after the urea-^{15}N infusion. Retention of ^{15}N from intravenously administered urea was markedly higher at the lower (70-76%) than at the higher nitrogen intake (44-62%). The amount of ^{15}N retained decreased in proportion to the increased mean level of ammonia in the rumen, plasma urea and the nitrogen excreted in urine in 24 hours. The amount of ^{15}N in the rumen fluid varied within a wide range (0-0%) in the course of the 9 days of the experiment. It reached a maximum 1-3 hours after the urea-^{15}N administration and again on the 4th-5th day after administration of the first dose of ^{15}N-urea. Levels were minimal on the 2nd-4th and 7th-9th day after the first administration. From the marked increase in ^{15}N content in the rumen fluid beginning on the 3rd and during the 4th-5th day of the experiment, when ^{15}N excretion in urine is at a minimum, it is concluded that ammonia originating from blood urea hydrolysis in the rumen wall, as well as from other as yet unidentified nitrogenous substances synthesized from this ammonia, is present in the rumen. From the relatively low content of ^{15}N in the rumen fluid and its relatively high retention, it is concluded that after hydrolysis to ammonia, blood urea nitrogen is utilized to a greater extent in the rumen wall and in tissues, and to a smaller extent by means of the rumen micro-organisms. The increased enrichment of nitrogen in ^{15}N in the content of the rumen, rumen wall, folded stomach and liver, in comparison with the content of the spleen, intestines, faeces, urine and kidney, after 9 days, demonstrates that the circulation of nitrogenous substances arising from blood urea takes place between the liver and forestomachs. In TCA precipitate from blood plasma, incorporation of ^{15}N from blood urea was demonstrated. In TCA precipitate from muscle tissue, ^{15}N incorporation was not evident. (auth)

29820 AMINO-ACID NUTRITION OF GROWING CATTLE. Chalupa, W. (Smith Kline Animal Health Products, Applebrook Research Center, West Chester, Pa. (USA)). pp 175-194 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Pro-

ceedings of a Research Coordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

Nitrogen-retention responses obtained from post-ruminal supplements of an essential amino-acids (EAA) mixture indicated that growing steers were not receiving adequate amounts of absorbable protein in relation to the net energy supplied by the diet for maintenance and growth. Comparable conclusions concerning utilization of abomasally infused EAA were reached with the classical N-balance method, evaluation of changes in plasma amino-acid profiles, and comparisons of estimated absorbable supplies versus requirements of protein and amino acids. The ability of dietary NPN and soybean meal to provide additional absorbable protein was considered. NPN provides absorbable protein only if the ammonia produced can be utilized for microbial growth. It was concluded that with the diets fed, insufficient energy was available in the rumen to produce the additional quantity of absorbable protein in the form of microbial protein. Soybean meal would supply absorbable protein in the form of rumen bypassed material, but ammonia from the rumen-degraded fraction would have to be utilized via the energy-dependent growth of rumen microbes. Protein supplements such as soybean meal do not provide adequate rumen energy for re-utilization of the ammonia they yield, and this energy deficit must be compensated for by other dietary ingredients. Unless additional ruminal losses were allowed, absorbable protein provided by dietary soybean meal would have been inadequate in Experiment 1, but would have exceeded the supply/requirement deficit in Experiments 2 and 3. Because rumen microbes can apparently scavenge ammonia from low concentration environments, and the use of ammonia for microbial growth is limited by energy availability, the magnitude of the rumen ammonia pool in relation to energy provided by dietary ingredients is the primary factor responsible for the effectiveness of NPN utilization. Within constant energy supplies, minimizing the rumen degradation of dietary protein should maximize NPN utilization. Using NPN for rumen protein production, bypassing dietary protein through the rumen, and if needed, supplementation with amino acids resistant to rumen degradation would appear to be a feasible approach to the production of animal protein with ruminants. (auth)

29821 RENAL BLOOD FLOW AFTER SELECTIVE INJECTION OF DIFFERENT DOSAGES OF DIATRIZOATE INTO THE RENAL ARTERY. An Experimental Study in the Dog. Burgener, F. A.; Fischer, H. W.; Weber, D. A. (Rochester Univ., N. Y. (USA). Dept. of Radiology). Fortschr. Geb. Roentgenstr. Nuklearmed.; 123: No. 4, 331-334(Oct 1975). (In German)

3 figs.; 22 refs.

The characteristic biphasic renal haemodynamic response to diatrizoate injected into the renal artery was shown in the dog with the 133-xenon washout technique. A brief increase in renal blood flow (RBF) during the first ten seconds is followed by a more prolonged period of diminished RBF. A dose of 4 ml. diatrizoate 60% resulted in the maximum RBF increase of 43% after ten seconds, but even 1 ml. diatrizoate raised the RBF 24%. The initial vasodilator effect of diatrizoate compares well in its extent with the most potent renal vasodilators. (DE)

29822 SOME STOICHIOMETRIC RELATIONS AND THEIR VALUE IN RUMEN STUDIES. Czerkawski, J. W. (The Hannah Research Inst., Ayr Scotland (UK)). pp 55-63 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

Stoichiometric relations in rumen studies are illustrated by examples showing how methanogenesis can account for excess reducing power arising during metabolism of glucose and primary alcohols. Experiments with (^{3}H)-labelled hydrogen, water and glucose strongly suggested that two atoms of the hydrogen in methane come from metabolism of glucose and two come from hydrogen gas through an intermediate that is in equilibrium with solvent water. A tentative scheme explains how an inhibition of methane production results in an accumulation of reduced co-factors and synthesis of higher fatty acids. When methane production is inhibited by adding large amounts of linseed oil to the ration of sheep the concentrations of VFA decline, but the VFA production rates increase. Evidence is presented that the syntheses of lipid and microbial protein also increase. It is stressed that NADPH or related hydrogen carriers might influence the extent of microbial protein synthesis, and that because the microbial protein is mainly in the form of enzymes which catalyze various metabolic and anabolic reactions, including protein synthesis, a feed-back control should be considered. (auth)

29823 EFFECT OF SOURCE OF ENERGY AND MINERALS ON MICROBIAL PROTEIN SYNTHESIS IN THE RUMEN USING LABELLED SULPHUR AS INDICATOR. Durand, M.; Gueguen, L.; Prieto, F.; Syzlit, O. (Centre National de Recherches Zootechniques (CNRZ), 78 - Jouy-en-Josas (France)). pp 29-42 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1974).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

The aim of this research was to promote maximum microbial protein synthesis from urea nitrogen by providing an adequate source of energy and minerals. Starches from three different varieties of maize, differing in their amylose content (25% for normal, 3% for waxy and 65% for amylomaize) and in their type of crystallinity, and three tropical tubers (capara, sweet potatoes and yam) were studied in vitro. Their effect on the rumen fermentation pattern and urea utilization was investigated with a standard artificial rumen technique, using labelled sulphur to estimate the rate of protein synthesis. Starch from amylomaize which gives a B-type X-ray diffraction pattern and shows a poor in-vitro susceptibility to α-amylase, strongly reduced urea-N consumption as well as VFA production when compared with normal or waxy maize starches. Yam, which also gives a B-type X-ray pattern and which is less susceptible to α-amylase than cassava or sweet potato, decreased urea consumption as well as VFA production when compared with the other tubers. A light processing (steam action followed by pelleting) applied to the tubers increased both urea utilization and VTA production. When $Na_2{}^{35}SO_4$ was added to the incubation medium, results of incorporation of radioactivity in the protein precipitate showed the same tendency as the results from urea consumption from the medium, but the results are not proportional. The validity of the ^{35}S method is discussed, and it is suggested that it is necessary to determine the sulphur content of the medium as well as the incorporation of radioactivity into amino acids from both supernatant and protein precipitate. These results show that cassava or sweet potato are adequate sources of energy for urea utilization; a weak process increases their energy availability further and greatly improves that of yam. The preliminary results obtained on minerals show that rumen contents from utez-cereal diets compared with an alfalfa hay diet are higher in P, Mn and Fe but lower in K. However, addition of various amounts of potassium to the incubation medium did not influence the fermentation pattern or improve urea utilization. (auth)

29824 STUDIES ON THE UTILIZATION OF NON-PROTEIN NITROGEN IN EGYPT. El-Shazly, K.; Borhami, B. E. A. (Alexandria Univ. (Egypt)). pp 153-163 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

The use of urea in the feeding of ruminants in Egypt to replace some of the protein-rich by-products is recommended for economic and technological reasons. The replacement of 50% of the protein-nitrogen by urea-nitrogen gave better results compared with 0, 30 and 70% replacement, when nitrogen balance was used as the criterion of N-utilization by sheep and goats. Goats were more efficient than sheep in utilizing nitrogen. Net growth measurement of microbial synthesis, ammonia-N concentration in the rumen, blood urea-N and plasma free-methionine, gave results that supported the nitrogen balance results. Better nitrogen utilization was observed as the period of feeding was extended, reflecting adaptation effect at the microbial and tissue levels. Alkali-treatment of corn stover improved its nutritive value and the

nitrogen utilization. The extent of improvement was more conspicuous for the diet containing cottonseed protein than for the diet in which 30% of the protein was replaced by urea. The preliminary results of a fattening experiment on cow and buffalo calves, using cottonseed-rice bran and urea-rice bran diets, indicate that the replacement of all the cottonseed-N by urea gave inferior results. Further work to improve urea-N utilization should take into consideration the addition of other sources of readily available carbohydrates, e.g., molasses, and of limiting amino acids. An in-vitro technique for measuring rates of NH_3-N production and bacterial synthesis was investigated to test the effects of handling and accumulation of end products. A simple method for determining amino-ethane-phosphonic acid is reported, and the possibility of using this as a marker for ciliate protozoa is discussed. (auth)

29825 ENERGY, WATER AND UREA METABOLISM IN THE LLAMA. von Engelhardt, W.; Becker, G.; Engelhardt, W.; Hauffe, R.; Hinderer, S.; Ruebsamen, K.; Schneider, W. (Stuttgart-Hohenheim Univ., Stuttgart (F. R. Germany). Departments of Vegetative Physiology and Animal Nutrition). pp 111-122 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

Energy, water and urea metabolism were measured in the llama at different levels of food or water restrictions. There was no difference between sheep and llamas in the digestibility of dry matter and cellulose; apparent crude protein digestibility was lower in llamas than in sheep. Energy and water metabolism in llamas, either in a respiration chamber or in a barn, was markedly lower than comparable values for sheep and cattle. Under grazing conditions, energy and water metabolism increased twofold. During water restriction but with hay fed ad lib., llamas consumed relatively more food than goats; the llama apparently accomplished this by a more economical use of water. A smaller volume of concentrated urine was produced by llamas than by goats. The total and the endogenous urea turnover rate in llamas seems to be of the same order of magnitude as in ruminants. The mean percentage of urea entering the gastrointestinal tract was larger, and the renal urea excretion smaller than in ruminants. An increase in energy intake resulted in an increase in the endogenous urea clearance (entry rate into GI tract divided by plasma urea concentration). Changes in the permeability of the gastrointestinal mucosa to urea are discussed. Under hay restriction, the renal plasma urea clearance decreased significantly; this was not caused by increased tubular reabsorption but by a decrease in the glomerular filtration rate. (auth)

29826 PASSAGE OF ^{144}Ce HAY PARTICLES, DNA, PROTEIN AND AMINO ACIDS FROM THE OMASUM OF SHEEP. Giesecke, D.; Erbersdobler, H. (Muenchen Univ. (F. R. Germany)); von Engelhardt, W. (Stuttgart-Hohenheim Univ., Stuttgart (F. R. Germany). Dept. of Vegetative Physiology). pp 133-140 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

The selective passage of particles through the omasum was investigated with a new technique for collecting whole omasal outflow and reticulum contents from sheep under physiological conditions, using ^{144}Ce-hay particles, Cr_2O_3 and PEG as markers. The composition and flow of nitrogen constituents suggested that the protein leaving the omasum was almost exclusively of microbial origin. Its increase in omasal outflow appeared to result from selective passage rather than from omasal metabolism. (auth)

29827 INCORPORATION OF ^{35}S BY RUMEN MICRO-ORGANISMS IN VITRO AT VARIOUS MICROBIAL GROWTH RATES. Harmeyer, J.; Martens, H.; Hoeller, H. (Tieraerztliche Hochschule Hannover (F. R. Germany). Physiologisches Inst.). pp 7-14 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

The incorporation of radioactive sulphur from $^{35}SO_4$ into the TCA-precipitable fraction of rumen microorganisms at various growth rates has been studied in vitro. Rumen fluid was obtained from sheep fed a purified protein-free diet with urea as the sole source of dietary nitrogen. All nitrogen precipitated with TCA was therefore taken as microbial nitrogen. Microbial growth in vitro proved to be dependent upon the amount of substrate added and varied between +100% and −17% during six hours of incubation. Sulphur incorporated per unit of precipitated nitrogen present at the end of incubation was found to be a complex function of microbial growth. Significant amounts of radiosulphur were incorporated even at no net growth or at substrate concentrations which reduced microbial growth drastically. In the light of these findings the applicability of ^{35}S incorporation as a measure of microbial protein synthesis in the rumen is evaluated critically. (auth)

29828 SURVIVAL AND SITE OF DESTRUCTION OF RADIOACTIVE LABELLED AUTOLOGOUS AND HOMOLOGOUS THROMBOCYTES. Beuerlein, I.; Mariss, P.; Stangel, W. (Medizinische Hochschule Hannover (F. R. Germany). Inst. fuer Nuklearmedizin und Spezielle Biophysik; Medizinische Hochschule Hannover (F. R. Germany). Abt. fuer Klinische Immunologie und Transfusionsmedizin). Nucl.-Med.; 14: No. 3, 240-247(Aug 1975). (In German).

3 figs.; 3 tabs.; 20 refs.

The kinetics of ^{51}Cr-labelled autologous and heterologous thrombocytes was studied in 12 health volunteers. The mean recovery value was 63% ($s_x = \pm 15\%$). The survival times ($t_{50\%}$ and $T_{10\%}$) were determined as 94 hrs. ($s_x = \pm 11$ hrs.) and as 202 hrs. ($s_x = \pm 13$ hrs.) respectively. The excess counts over spleen and liver were measured and the spleen to liver ratio calculated. In every parameter investigated no significant difference between autologeous and heterologeous labelled thrombocytes could be found. The excess counts over spleen and liver were calculated on the basis of the radioactivity of blood and of the heart surface area. The values obtained from the blood radioactivity calculations showed significant lower variation coefficients than the corresponding-values derived from the heart measurements. (DE)

29829 USE OF ^{35}S TO ESTIMATE THE PROPORTION OF DIETARY PROTEIN DEGRADED IN THE RUMEN. Hume, I. D. (New England Univ., Armidale (Australia). Dept. of Biochemistry and Nutrition). pp 1-6 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture.

Incorporation of ^{35}S into ruminal microbial protein has been used to determine the relative proportions of microbial and dietary nitrogen entering the duodenum, and hence the proportion of the dietary protein escaping fermentation in the rumen. Two experiments are described to illustrate applications of the technique. In the first experiment less fish meal (29%) and soybean meal protein (39%) than peanut meal (63%) and lupin meal protein (65%) was degraded in the rumen. This was related to lower ruminal concentrations of ammonia, and greater retention of nitrogen by the animals when fish meal or soybean meal was fed than when peanut or lupin meal was fed. In the second experiment the protein in subterranean clover was degraded in the rumen to a greater extent (73%) when the clover was immature than when it had wilted and matured (43%). In this instance nitrogen retention was not directly related to the amount of dietary protein escaping ruminal proteolysis, because of differences in post-ruminal digestibility of the dietary protein, and because of differences in microbial protein production in the rumen, both of which were estimated from data derived using the ^{35}S-incorporation technique. (auth)

29830 EFFECT OF DIETARY NITROGEN LEVEL ON ELECTROLYTE AND WATER METABOLISM IN SHEEP: K^+ METABOLISM. Juhasz, B.; Szegedi, B.; Keresztes, M. (Dept. of Physiology, Inst. of Animal Husbandry, Budapest, Hungary). pp 123-131 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division

of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

The distribution of ^{42}K between whole blood, plasma and erythrocytes eas studied in sheep after the intra-ruminal administration of urea (0.6-0.8 g/kg body weight), at rising concentrations of blood ammonia. The ammonia content of rumen fluid and blood, and the haematocrit value were determined. The ^{42}K was administered intravenously. The activities of blood, plasma and erythrocytes were determined at zero time and 1.5, 3, 4.5, 6 and 8 hours after the administration of urea. In sheep given urea, the ^{42}K activity of the plasma decreased more markedly than in the controls, and there was a simultaneous reduction in the ^{42}K activity of whole blood. Unlike controls, the erythocytic ^{42}K activity also fell. It seems that the rise in the blood ammonia level inhibits the transport of K^+ from the extracellular space into the cells, and promotes the release of K^+ from the cells by diffusion. It was found that owing to the inhibitory action of ammonia, a correlation exists between the rise of blood ammonia level and the distribution quotient of K^+. The higher the blood ammonia level, the greater the inhibition of K^+-transport towards the erythrocytes. A regression equation is presented which expresses the relationship between blood ammonia level and the k-distribution quotient. (INIS)

29831 BASIC CHARACTERISTICS OF A COMPUTER-SIMULATED MODEL OF NITROGEN UTILIZATION IN THE GRAZING RUMINANT. Morris, J. G.; Baldwin, R. L.; Maeng, W. J.; Maeda, B. T. (California Univ., Davis (USA)). pp 65-79 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

A method for constructing a computer-simulated model of nitrogen utilization in the grazing ruminant is described. The quantitative information required to construct a model such as dietary and recycled nitrogen, microbial synthesis and digestion, and the relative importance of fore and hind guts is discussed. Experimental estimates of the parameters and the factors that affect them have been incorporated into a model which is now being used to indicate particular areas where further, more detailed, experimental data are required. (auth)

29832 MEASUREMENT OF METHANE PRODUCTION IN SHEEP. Murray, R. M.; Bryant, A. M.; Leng, R. A. (New England Univ., Armidale (Australia). Dept. of Biochemistry and Nutrition). pp 21-27 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

A radioisotope technique is described for the measurement of methane production in sheep. Although the technique requires major attention to detail, once established it is simple, accurate and economical. It differentiates upper and lower tract methane production. A model of methane production and movement in sheep fed on 800 g lucerne chaff is presented. In sheep over a wide range of intakes of lucerne chaff, the ratio of ruminal VFA production to methane production was 5.3 moles/mole. This relationship was consistent with previously published chemical relationships of intakes in fermentation. (auth)

29833 USE OF ^{32}P TO ESTIMATE MICROBIAL SYNTHESIS IN THE RUMEN. van Nevel, C. J.; Demeyer, D. I.; Henderickx, H. K. (Ghent Rijksuniversiteit (Belgium)). pp 15-19 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

To estimate microbial synthesis in the rumen a method based on the incorporation of ^{32}P is proposed. The method makes use of the facts that the phosphate pool is large and the turnover low, and that the phosphorus concentration in the microbial dry matter is constant in the experimental conditions. Results obtained with this method correspond with those from other methods. (auth)

29834 MICROBIAL PROTEIN SYNTHESIS BY BOVINE RUMEN CONTENT IN RELATION TO AMMONIA CONCENTRATION. Nikolic, J. A.; Jovanovic, M.; Filipovic, R. (Institut za Primeni Nuklearne Energije u Poljoprivedri, Veterinarstvu i Sumarstvu, Zemun (Yugoslavia)). pp 43-54 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

The influence of ammonia concentration on microbial protein synthesis has been investigated in a simple in-vitro system in which rumen fluid from a Simmental bull was incubated with buffer, diet and tracer in small transfusion bottles. The steady increase in volatile fatty acid concentrations, the constant evolution of H_2S and the accompanying decrease in pH of the incubation mixture showed that microbial activity was continuous for up to four hours incubation. Protozoa remained actively motile when the pH remained above 5.6. Using ^{15}N-urea to label the ammonia pool and measuring the rate of incorporation of ^{15}N into acid insoluble material, it was possible to calculate the rate of incorporation of ammonia nitrogen into microbial cells. It was found that the overall utilization rate of ammonia-N was not significantly affected by mean concentrations of ammonia between 1.6 mg and 16.7 mg N/100 m litre because the fractional turnover rate of the ammonia pool increased as the concentration of ammonia decreased. Moreover, the overall rate of protein synthesis appeared to be largely unaffected by the concentration of ammonia in the incubation vessels whether ^{15}N or ^{35}S was used as the tracer. However, net protein synthesis as indicated by utilization of added non-protein nitrogen and changes in ammonia concentration during incubation was reduced as the supply of non-protein nitrogen was decreased. It is suggested that protein catabolism may be increased at low concentrations of ammonia-N, and that the concentration of ammonia-N optimal for net protein production is about 6 mg/100 m litre under the conditions used. (auth)

29835 EFFECT OF FORMALDEHYDE TREATMENT OF HORSE BEANS (VICIA FABA) ON THE NUTRITIONAL VALUE FOR SHEEP. Pisulewski, P.; Rys, R. (Dept. of Animal Nutrition, Inst. of Zootechnics, Cracow, Poland). pp 195-198 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

The effect of formaldehyde treatment of horse beans (Vicia faba) on nitrogen balance, plasma urea levels, daily gains and conversion efficiency of concentrate diets was studied in growing lambs. The treatment decreased the solubility of the horsebean protein, slightly reduced the rumen ammonia level, but increased the plasma urea level. Nitrogen retention was not affected by the treatment and gain, and conversion efficiency was not favorably affected. (auth)

29836 UTILIZATION OF UREA/MOLASSES LIQUID FEED AS THE MAIN SOURCE OF NITROGEN AND ENERGY FOR CATTLE AND BUFFALO. Ranjhan, S. K.; Pathak, N. N.; Singh, U. B.; Verma, D. N.; Varma, A. (Indian Veterinary Research Inst., Izatnagar, Uttar Pradesh). pp 165-173 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in

Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

Experiments in which urea/molasses liquid diets, with various roughages and protein supplements, have been fed to cattle and buffalo are described. Information is presented on the effects of the liquid diet on the components of feed utilization such as intake, digestibility and nitrogen balance, together with other parameters relating to efficient rumen metabolism such as volatile fatty acid production rates and proportions, and rumen microbial counts. Rates of gain and feed efficiencies are also presented. (auth)

29837 ALLANTOIN IN URINE AS AN INDEX OF MICROBIAL PROTEIN IN THE RUMEN. Rys, R.; Antoniewicz, A.; Maciejewicz, J. (Dept. of Animal Nutrition, Inst. of Zootechnics, Cracow, Poland). pp 95-98 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants. Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

A method of estimating the conversion of dietary nitrogen into microbial nitrogen based on the excretion of allantoin and uric acid is described. The assumptions made in the calculations and the relation to estimates based on other markers is presented. (auth)

29838 SYNTHESIS AND DIGESTION OF MICROBIAL NITROGEN COMPOUNDS AND VFA PRODUCTION BY THE BOVINE. Smith, R. H.; Salter, D. N.; Sutton, J. D.; McAllan, A. B. (National Inst. for Research in Dairying, Reading (UK)). pp 81-93 of Tracer Studies on Non-Protein Nitrogen for Ruminants II. Proceedings of a Research Co-ordination Meeting and Panel on Tracer Techniques in Studies on the Use of Non-Protein Nitrogen (NPN) in Ruminants Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and Held in Vienna, 18-22 February 1974. Vienna; IAEA (1975).

From panel on tracer techniques in studies on the use of non-protein nitrogen (NPN) in ruminants; Vienna, Austria (18 Feb 1974). (International Atomic Energy Agency, Vienna (Austria). Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture).

Doses of ^{15}N-urea infused into the rumens of protozoa-free calves given isonitrogenous diets containing different proportions of urea and decorticated groundnut meal were partly accountable (15-33%) as ammonia 1 h later. Only 3-8% was accountable in bacteria suspended in rumen fluid so the majority, at least for the low-urea feeds, appeared to have been incorporated into bacteria associated with food particles or the rumen wall. After a high-urea feed, ammonia in the rumen remained at a fairly high and constant concentration between 1 and 7 h after feeding but its ^{15}N enrichment decreased considerably indicating considerable re-cycling of ammonia into the rumen. Consideration of ^{15}N enrichments in samples of rumen bacteria and duodenal contents in relation to marker (PEG) recoveries indicated that more of the ^{15}N-urea dose was incorporated into bacteria entering the duodenum when it was given with a low, rather than a high, urea diet. A comparison of two methods of determining the contribution of nitrogen compounds of microbial origin to total nitrogen at the duodenum (using RNA and diaminopimelic acid respectively as markers) showed good agreement for a calf given a number of diets but marked discrepancies for a cow. The discrepancies were probably due to the presence of protozoa in the cow, and could perhaps form a basis for assessing the contribution of protozoal nitrogen compounds at the duodenum. It was also shown that the chemical composition of rumen bacteria varied under different conditions in such a way that the nutritional value of the bacteria to the host animal might be markedly affected. Digestibilities of ^{15}N in labelled rumen bacteria and plant protein were measured by infusing these materials with a marker into the duodenum of a calf and examining digesta from the ileum. Results showed the true digestibility of plant protein to be high (70-80%) but that of bacterial N compounds to be lower and variable (40-70%). Such variations might also affect the nutritional value of the bacteria to the host animal. Production of VFA in the rumen was assessed for cows given diets either twice a day or in small amounts at hourly intervals, by measuring the dilution rate of 1-^{14}C-acetic acid infused into the rumen. For frequent feeding the proportion of digestible energy accountable as VFA appeared to be markedly greater than for intermittent feeding, an effect which would influence the energy available for microbial protein synthesis. It is, however, possible that the apparent differences were due to a lack of steady state conditions when VFA production was assessed with intermittent feeding. (auth)

29839 RADIOISOTOPE SCANNING OF THE LUNGS IN SIDEROSILICOTUBERCULOSIS. Brodskii, O. B.; Malov, V. V. Probl. Tuberk.; 52: 89(1974). (In Russian)

The results obtained in lung scanning using albumin microspheres labelled with ^{131}I were reported from studies on 49 patients with ages from 31 to 60 years. It was concluded that radioisotopic scanning used in conjunction with other clinical and x-ray methods was useful for defining more precisely the character of the change in the lungs of patients with coniotuberculosis. (JSR)

29840 VISUAL DETECTION AND LOCALIZATION OF RADIOGRAPHIC IMAGES. Starr, S. J.; Metz, C.; Lusted, L. B.; Goodenough, D. J. (Johns Hopkins Medical Inst., Baltimore). Radiology; 116: No. 3, 533-538(Sep 1975).

In conventional receiver-operating-characteristic (ROC) curve analysis of visual detection performance, the observer is credited with a true-positive response if a visual signal is present somewhere in a radiograph called "positive" by the observer; however, the measured true-positive rate can be different for a given false-positive rate if the observer is required to identify the correct location of the visual signal in order to receive credit for a true-positive response. The authors describe and have confirmed experimentally a model which can be used to predict observer performance in an experiment requiring both detection and localization on the basis of the conventional ROC curve determined in a detection experiment. Implications for the use of signal detection theory in the assessment of radiographic image quality are discussed.

29841 MEASURES OF CLINICAL EFFICACY. III. The Value of The Lung Scan In The Evaluation of Young Patients With Pleuritic Chest Pain. McNeil, B. J.; Hessel, S. J.; Branch, W. T.; Bjork, L.; Adelstein, S. J. (Harvard Medical School, Boston). J. Nucl. Med.; 17: No. 3, 163-169(Mar 1976).

The usefulness of various modalities in evaluating pleuritic pain in young patients and in isolating cases of pulmonary embolism was assessed using likelihood ratios and the receiver operating characteristic (ROC) curve. History and physical, laboratory, and radiographic findings were used disjunctively to establish an ROC curve. The percentage of patients found to have pulmonary embolism increased monotonically with certain critical pieces of diagnostic data. For example, a history and physical examination alone detected 80 percent of patients with pulmonary embolism; a chest radiograph raised the percentage to 95 percent; and the addition of a lung scan increased the percentage to 100 percent. Thus, with proper interpretation of clinical and radiographic data, the lung scan has only a marginal impact upon the sensitivity with which pulmonary embolism is detected. Its major value is an increased specificity in the diagnosis of pulmonary embolism. (auth)

29842 USE OF ^{99m}Tc-LABELED ALBUMIN MICROSPHERES IN CEREBRAL VASCULAR DISEASE. Verhas, M.; Schoutens, A.; Demol, O.; Patte, M.; Rakofsky, M.; Struyven, J.; Capon, A. (Hopital Universitaire Brugmann, Brussels). J. Nucl. Med.; 17: No. 3, 170-174(Mar 1976).

The intracarotid injection of radioalbumin microspheres (15 and 30 mu m) is followed by scanning procedures that permit the description of the cerebral bloodflow distribution. The method is reproducible. Injection can be made into the internal and common carotid arteries, as well as into the aortic arch or the left ventricle. This last procedure makes it easy to examine patients with severe extracranial vascular stenosis or thrombosis and permits comparison of the two hemispheres. Most patients (88 percent) injected on the affected side showed one or more local vascular deficits. The method therefore is more efficient than pertechnetate scanning or arteriography. (auth)

29843 COMPARATIVE EVALUATION OF RENAL TRANSPLANT REJECTION WITH RADIOIODINATED FIBRINOGEN, ^{99m}Tc—SULFUR COLLOID, AND ^{67}Ga-CITRATE. George, E. A.; Codd, J. E.; Newton, W. T.; Haibach, H.; Donati, R. M. (St. Louis Veterans Administration Hospital). J. Nucl. Med.; 17: No. 3, 175-180(Mar 1976).

The diagnostic accuracy, ease, and technical feasibility of imaging with ^{131}I- or ^{125}I-fibrinogen, ^{99}/sup m/Tc-sulfur colloid, and ^{67}Ga-citrate in renal transplant rejection are compared. Radiofibrinogen data resulted from literature review, radiocolloid data from 125 studies in 52 transplant patients, and gallium citrate data from 24 examinations in seven renal transplant patients performed simultaneously with the radiocolloid studies. Specificity of graft labeling during rejection appears to

be similar with radiofibrinogen, ^{99}/sup m/Tc-sulfur colloid, and ^{67}Ga-citrate. For routine clinical use ^{99}/sup m/Tc-sulfur colloid surpasses radiofibrinogen and radiogallium because of its better imaging qualities with a permissible radiation dose, leading to better separation of positive and negative results. The ^{99}/sup m/Tc-sulfur colloid accumulates in areas of intravascular fibrin thrombosis in acute and chronic rejecting renal transplants. Hence, the mechanisms for accumulation of ^{99}/sup m/Tc-sulfur colloid and labeled fibrinogen in rejecting transplants would seem to be similar. Such physiologic properties as rapid blood clearance and such physical properties as short physical half-life combine to produce reliable graft visualization with adequate definition, thus favoring ^{99}/sup m/Tc-sulfur colloid as the single agent of choice for clinical evaluation of renal transplant rejection at this time. (auth)

29844 USE OF ^{99m}Tc-SULFUR COLLOID IN EVALUATION OF RENAL TRANSPLANT COMPLICATIONS. Frick, M. P.; Loken, M. K.; Goldberg, M. E.; Simmons, R. L. (Univ. of Minnesota Hospitals, Minneapolis). J. Nucl. Med.; 17: No. 3, 181-183(Mar 1976).

Technetium-99m-sulfur colloid (TSC) was administered to 45 renal transplant patients. No TSC accumulation was seen in normally functioning transplant kidneys. Accumulation of TSC was found in 89 percent of transplants with rejection, in 30 percent of transplants exhibiting acute tabular necrosis, and in 30 percent of transplants of patients with sepsis. Renal accumulation of TSC in various transplant complications diminishes the value of this technique for monitoring transplant rejection. (auth)

29845 SERIAL BONE-SCAN CHANGES IN RECURRENT BONE INFARCTION. Greyson, N. D.; Kassel, E. E. (Mount Sinai Hospital, Toronto). J. Nucl. Med.; 17: No. 3, 184-186 (Mar 1976).

Recurrent bone infarcts in a black man produced a changing pattern of bone-scan abnormalities. Areas initially cold at the infarction site returned to normal over a period of months. Hyperconcentration was frequently noted during the healing phase. In the acute phase scanning was specific and more sensitive than radiography. (auth)

29846 OSTEOBLASTOMAS OF THE AXIAL SKELETON SHOWN BY SKELETAL SCANNING: CASE REPORT. Martin, N. L.; Preston, D. F.; Robinson, R. G. (Univ. of Kansas Medical Center, Kansas City). J. Nucl. Med.; 17: No. 3, 187-189(Mar 1976).

Two patients with osteoblastoma of the axial skeleton showed intense uptake of ^{99}/sup m/Tc-polyphosphate and ^{99}/sup m/Tc-diphosphonate on skeletal scans. Although this lesion is uncommon, it should be included in the differential diagnosis for young patients who show abnormal accumulation of ^{99}/sup m/Tc-phosphates in the axial skeleton. (auth)

29847 ABNORMAL RADIONUCLIDE ANGIOGRAM IN PROVEN INTRACRANIAL FIBROMUSCULAR DYSPLASIA: CASE REPORT. Fitzer, P. M.; Rinaldi, I. (Riverside Hospital, Newport News, Virginia). J. Nucl. Med.; 17: No. 3, 190-192(Mar 1976).

Left internal carotid occlusion with collateral perfusion was shown by radionuclide and contrast angiography in a 22-year-old woman. Fibromuscular dysplasia, intimal fibroplasia type, was found at autopsy in the intracranial carotid, vertebral, and basilar arteries. (auth)

29848 DISPLACEMENT OF THE SPLEEN IN INFECTED PANCREATIC PSEUDOCYST: CASE REPORT. Grant, R. W.; Ackery, D. (Southampton General Hospital, Eng.). J. Nucl. Med.; 17: No. 3, 193-195(Mar 1976).

In two patients with infected pancreatic pseudocyst ^{99}/sup m/Tc-sulfur colloid scans showed similar medial and inferior displacement of the spleen. (auth)

29849 EPIDERMOID CYST OF THE SPLEEN: CASE REPORT. Garfunkel, F. (Wright State Univ. School of Medicine, Xenia, OH). J. Nucl. Med.; 17: No. 3, 196-199(Mar 1976).

The classification, incidence, and clinical, radiologic, and scintigraphic findings of benign nonparasitic splenic cysts are presented with a case report of epidermoid cyst of the spleen. (auth)

29850 RESIDUAL SPLENIC FUNCTION IN THE PRESENCE OF THOROTRAST-ASSOCIATED HEPATIC TUMOR: CASE REPORT. Spencer, R. P.; Turner, J. W.; Syed, I. B. (Univ. of Connecticut Health Center, Farmington). J. Nucl. Med.; 17: No. 3, 200-202(Mar 1976).

A 50-year-old man had received intravenous colloidal thorium dioxide (thorotrast) 27 years previously. Scintiscans with both ^{99}/sup m/Tc-sulfur colloid and ^{131}I-rose bengal revealed an extensive intrahepatic defect. At operation, the lesion proved to be an infiltrating hemangiosarcoma. The spleen was small but the chronic internal radiation of the spleen had not completely destroyed the function of radiocolloid uptake. Review of the literature disclosed other cases in which the spleen was still capable of accumulating radiocolloid some years after thorotrast administration. In at least one other instance, radiocolloid uptake was not accompanied by splenic ability to clear Howell–Jolly bodies: a disassociation of splenic functions. The effects of the internal radiation dose to the spleen from thorotrast are discussed and compared with the effects of external radiation. The discrepancy between the effects of the two doses may be related to the high relative biologic effectiveness of the alpha rays from thorotrast compared with x-radiation, to nonuniformity of distribution, and to the effects of reticuloendothelial blockade. (auth)

29851 RAT MODEL FOR ACUTE MYOCARDIAL INFARCTION: APPLICATION TO TECHNETIUM-LABELED GLUCOHEPTONATE, TETRACYCLINE, AND POLYPHOSPHATE. Adler, N.; Camin, L. L.; Shulkin, P. (New England Nuclear Corp., North Billerica, MA). J. Nucl. Med.; 17: No. 3, 203-207 (Mar 1976).

Cauterization of rat myocardium serves as a quick (2 min) inexpensive technique to create an animal model of acute myocardial infarction useful in evaluating radiopharmaceuticals as potential clinical imaging agents. Preliminary evidence indicates that it correlates well with behavior in man. Application of the model led to the discovery, confirmed by later investigators, that chelating agents such as glucoheptonate and polyphosphate show significant uptake in recent myocardial lesions. (auth)

29852 CHEMISTRY OF ^{99m}Tc TRACERS. II. In Vitro Conversion of Tagged HEDP and Pyrophosphate (Bone-Seekers) Into Gluconate (Renal Agent). Effects of Ca and Fe(II) on In Vivo Distribution. McRae, J.; Hambright, P.; Valk, P.; Bearden, A. J. (Univ. of California, Berkeley). J. Nucl. Med.; 17: No. 3, 208-211(Mar 1976).

Sodium gluconate transforms the bone-seekers ^{99}/sup m/Tc-HEDP and ^{99}/sup m/Tc-pyrophosphate into the renal agent ^{99}/sup m/Tc-gluconate. In these in vitro processes, pyrophosphate is displaced faster than HEDP, while the HEDP reaction is accelerated by calcium ions. The in vivo distributions of these bone and kidney agents are altered by the prior local injection of calcium or iron(II). These transformation and translocation phenomena are explained in terms of the mechanistic behavior of Tc(IV) complexes. (auth)

29853 SELENIUM-75-19-SELENOCHOLESTEROL: A NEW ADRENAL SCANNING AGENT WITH HIGH CONCENTRATION IN THE ADRENAL MEDULLA. Sarkar, S. D.; Ice, R. D.; Beirwaltes, W. H.; Gill, S. P.; Balachandran, S.; Basmadjian, G. P. (Univ. of Michigan Medical Center, Ann Arbor). J. Nucl. Med.; 17: No. 3, 212-217(Mar 1976).

A tissue distribution study with ^{75}Se-19-selenocholesterol in rats, rabbits, and dogs showed high adrenal concentrations and good adrenal images. In the dog, higher concentrations were obtained in the adrenal medulla than in the cortex at Days 1 and 7 after dosing. Extraction and thin-layer chromatography of the adrenal lipid in dogs given this compound showed that ^{75}Se in the adrenal is still attached to the steroid moiety. A reduction in production costs is expected from its longer shelf life. Selenium-75-19-selenocholesterol is being evaluated in humans not only for routine use as an adrenal cortex scanning agent, but also for the detection of pheochromocytomas and other sympathetic tissue tumors, especially neuroblastomas. (auth)

29854 RADIORESPIROMETRIC STUDY OF CARBOHYDRATE METABOLISM IN CHILDHOOD LIVER DISEASE. DaCosta, H.; Shreeve, W. W.; Merchant, S. (Veterans Administration Hospital, Northport, NY). J. Nucl. Med.; 17: No. 3, 218-219(Mar 1976).

The need for a suitable parameter to evaluate patients with chronic liver disease has been felt for some time, especially in order to judge the response to surgical shunts and the influence of certain drugs and diets on the liver. Since the liver is a major organ for carbohydrate metabolism, it was decided to analyze the in vivo oxidation of such substrates as glucose and galactose labeled with ^{14}C. Moderately advanced "Indian childhood cirrhosis" and idiopathic fatty hepatic infiltration were selected to represent diffuse chronic liver disease. Oral administration of ^{14}C-U-glucose or ^{14}C-1-galactose was followed by analyses of $^{14}CO_2$ in breath by liquid scintillation counting. Conversion of ^{14}C-glucose to $^{14}CO_2$ was accelerated by both diseases. On the other hand, oxidation of ^{14}C-galactose was slowed in fatty infiltration and was markedly subnormal in Indian childhood cirrhosis. (auth)

29855 ISOLATION OF ANTIBODIES SPECIFIC TO SICKLE HEMOGLOBIN BY AFFINITY CHROMATOGRAPHY USING A SYNTHETIC PEPTIDE. Young, N. S.; Curd, J. G.; Eastlake, A.; Furie, B.; Schechter, A. N. (National Inst. of Health, Bethesda,

MD). Proc. Natl. Acad. Sci. U.S.A.; 72: No. 12, 4759-4763(Dec 1975).

Antibodies to hemoglobin have been studied with a radioimmunoassay which employs [^{14}C]carbamylated (equals carbamoylated) hemoglobin S. An antiserum raised against hemoglobin S, which initially discriminated poorly between hemoglobins S and A, was fractionated by absorption to a column of Sepharose to which a synthetic peptide corresponding to the first 13 amino-acid residues of the beta chain of sickle hemoglobin had been covalently bound. A subpopulation of the antiserum was eluted from this column with 4 M guanidine · HCl. These antibodies showed binding to hemoglobin S but not to hemoglobin A and this interaction could be inhibited by the synthetic peptide. These antibodies, of demonstrated fine structural specificity, may be useful in the detection of sickle hemoglobin and in the study of its structure in solution. (auth)

29856 YEAR BOOK OF NUCLEAR MEDICINE 1976. Quinn, J. L. III. Chicago; Year Book Medical Publishers, Inc. (1976). 380p. $23.50.

Subjects of interest are discussed under the following headings: computerized axial tomography; radiation physics and instrumentation; radiochemistry and radiopharmacology; and health physics and radiobiology. Nuclear medical applications in the following systems are also discussed: endocrine system; hemopoietic and lymphatic systems; genitourinary system; central nervous system; gastrointestinal system; heart and great vessels; pulmonary system; and osseous and cartilaginous systems. (ERB)

29857 NEONATAL CHANGES IN RENAL BLOOD FLOW DISTRIBUTION IN PUPPIES. Aschinberg, L. C.; Goldsmith, D. I.; Olbing, H.; Spitzer, A.; Edelmann, C. M. Jr.; Blaufox, M. D. (Albert Einstein Coll. of Medicine, Bronx, NY). Am. J. Physiol.; 228: No. 5, 1453-1461(May 1975).

The intrarenal distribution of blood flow was studied in 31 newborn mongrel puppies from 18 h to 70 days using xenon washout and krypton autoradiography. Mean renal blood flow increased from 0.39 +- 0.05 ml/g per min (SE) the 1st wk to 2.06 +- 0.12 ml/g per min at 6 wk. During the 1st wk of life the renal cortex was perfused homogeneously at 0.88 +- 0.19 ml/g min (SE) and accounted for 35 +- 4 percent of the renal blood flow. During the 2nd wk a narrow, rapidly perfused zone of outer cortex was identified which was perfused at 3.35 +- 0.26 ml/g per min, received 19.53 +- 5.05 percent of the total renal blood flow, and represented 15 +- 4 percent of the mass of the total cortex. The inner cortex and outer medulla at this time received 53.40 +- 4.12 percent of the flow at 1.07 +- 0.08 ml/g per min. Outer cortical flow increased with age reaching adult values by about 6 to 10 wk when the rapidly perfused area represented 40 +- 8 percent of the cortex. These changes are parallel to the results of previously reported studies with microspheres in newborn puppies and are compatible with the well-established maturational changes noted in neonates of several species. They represent the first gas-washout studies in animals during the first 6 wk of life. (auth)

29858 UTEROPLACENTAL BLOOD FLOW DURING ALKALOSIS IN THE SHEEP. Buss, D. D.; Bisgard, G. E.; Rawlings, C. A.; Rankin, J. H. G. (Univ. of Wisconsin, Madison). Am. J. Physiol.; 228: No. 5, 1497-1500(May 1975).

Uteroplacental blood flow was measured by the radioactive-microsphere technique in eight near-term pregnant ewes during a normal control period and during maternal metabolic alkalosis. All measurements were made on awake, unanesthetized animals. Alkalosis, defined for this study as an arterial pH of 7.60 or greater, was produced by the oral administration of sodium bicarbonate, 3 g/kg body wt. The rise in pH thus produced was unaccompanied by significant changes in systemic arterial blood pressure and cardiac output, while maternal arterial P/sub CO_2/ rose slightly from control levels. Cotyledonary blood flow declined from a control value of 1.177 ml/min to 1.025 ml/min during alkalosis. This decline of 13 percent in cotyledonary blood flow is significant (P less than 0.02). Blood flow to the remaining uterine tissue, or noncotyledonary uterus, did not change with alkalosis, being maintained at approximately 195 ml/min. It is concluded that maternal alkalosis, unaccompanied by major changes in P /sub CO_2/ and systemic arterial pressure, causes a small increase in the resistance of the uteroplacental circulation. (auth)

29859 SOLID-PHASE RADIOIMMUNOASSAY FOR HUMAN PROSTATIC ACID PHOSPHATASE. Foti, A. G.; Herschman, H.; Cooper, J. F. (Southern California Permanente Medical Group, Los Angeles). Cancer Res.; 35: No. 9, 2446-2451(Sep 1975).

A solid-phase technique for radioimmunoassay of human prostatic acid phosphatase (EC 3.1.3.2) is described. Human prostatic acid phosphatase was purified from prostatic fluid. Monospecific antisera to the purified acid phosphatase were produced in rabbits. Disposable polypropylene tubes were coated with antiserum and used for radioimmunoassay with ^{125}I-acid phosphatase. The nonspecific binding was minimized by saturating the binding sites of the tubes with bovine serum albumin. The working range of the technique was 1 to 30 ng of antigen. The solid-phase radioimmunoassay is rapid, sensitive, and efficient. In preliminary clinical trials it was shown that (a) patients with advanced prostatic cancer had elevated prostatic acid phosphatase levels by both enzymatic assay and radioimmunoassay assays, and (b) patients with other cancers were in the normal range for prostatic acid phosphatase. (auth)

29860 RIGHT VENTRICULAR DYSFUNCTION DETECTED BY GATED SCINTIPHOTOGRAPHY IN PATIENTS WITH ACUTE INFERIOR MYOCARDIAL INFARCTION. Rigo, P.; Murray, M.; Taylor, D. R.; Weisfeldt, M. L.; Kelly, D. T.; Strauss, H. W.; Pitt, B. (Johns Hopkins Univ., Baltimore). Circulation; 52: No. 2, 268-274(Aug 1975).

Twenty-seven patients with acute myocardial infarction not complicated by cardiogenic shock and ten normal volunteers were studied with gated cardiac blood pool scans. The ratio of right ventricular area/left ventricular area (RVA/LVA) determined from the left anterior oblique end-diastolic scans was examined. The ratio was 1.11 +- 0.06 in the normal volunteers. In patients with anterior infarction the ratio fell to 0.75 +- 0.12 (P less than 0.05) due to left ventricular enlargement. In those with inferior infarction the ratio was 1.12 +- 0.23 which was greater than in those with anterior infarction (P less than 0.05) due to enlargement of both the left and right ventricles. Six patients with cardiogenic shock, three with inferior and three with anterior infarction were studied. The three with anterior infarction had left ventricular enlargement and a decrease in the ratio of RVA/LVA to 0.62 while the three with inferior infarction had an increase in the ratio to 2.05 suggesting right ventricular dilatation and dysfunction. These studies suggest a high incidence of right ventricular dysfunction in patients with inferior myocardial infarction. (auth)

29861 PREPARATION OF ^{125}I-LABELED HUMAN THYROXINE-BINDING ALPHA GLOBULIN AND ITS TURNOVER IN NORMAL AND HYPOTHYROID SUBJECTS. Cavalieri, R. R.; McMahon, F. A.; Castle, J. N. (Veterans Administration Hospital, San Francisco). J. Clin. Invest.; 56: No. 1, 79-87(Jul 1975).

A protein with the electrophoretic, immunologic, and hormone-binding properties of thyroxine-binding globulin (TBG) has been prepared from human plasma and labeled with radioiodine (^{125}I) by an enzymatic method of iodination. The [^{125}I]TBG retained the electrophoretic and immunologic characteristics of unlabeled TBG but exhibited a partial loss of thyroxine-binding activity, as assessed by affinity chromatography. The in vivo behavior of [^{125}I]-TBG was studied in six euthyroid subjects (controls) with normal serum levels of TBG as measured both by radioimmunoassay and by determination of maximal T_4-binding capacity and in four male patients with untreated primary hyperthyroidism, three of whom had elevated serum TBG. The half-time of the final slope of the plasma disappearance curve averaged 5.0 days +- 1.2 (SD) in the controls and ranged from 3.9 to 10.9 days in the hypothyroid patients. The distribution volume was similar in the two groups, 6.7 +- 1.3 vs. 7.1 +- 2.1 liters. The catabolic clearance rate averaged 0.99 +- 0.33 liters plasma/24 h in the controls and 0.92 +- 0.46 in the hypothyroids. The absolute turnover rate of TBG, calculated from the catabolic clearance rate multiplied by the serum concentration of radioimmunoassayable TBG, averaged 17.8 +- 2.1 mg/day in the controls and ranged from 14.8 to 33.2 mg/day in the hypothyroids. Among the entire group of subjects there was no correlation between the serum TBG concentration and the absolute turnover rate of TBG. (auth)

29862 THYROID NODULE. McKenney, J. F. (Scott and White Clinic, Temple, TX). Postgrad. Med.; 57: No. 7, 103-105 (Jun 1975).

A palpable mass or nodule may represent any one of a large and diverse group of conditions that involve the thyroid. Whether the patient is euthyroid, hypothyroid, or hyperthyroid can be assessed, and the cause of hypofunction or hyperfunction can usually be determined. Scintiscanning provides important information on the anatomic structure of thyroid nodules. A hot nodule should be ablated by either radioiodine or surgery. A warm nodule usually responds to suppression therapy; if regression does not occur, the problem should be reevaluated. A cold nodule should be surgically excised, as microscopic study of such a lesion is mandatory. (auth)

29863 FEVER OF UNKNOWN ORIGIN AND THE VALUE OF GALLIUM-67 AND TECHNETIUM-99/sup M/ FOR DEFINING ABNORMALITY OF THE SPLEEN: A CASE REPORT. Coopersmith, A.; Ritchey, A. K.; Zinkham, W. H. (Johns Hopkins Hospital, Baltimore). Johns Hopkins Med. J.; 137: No. 1, 51-54(Jul 1975).

A three-year-old white female with acute promyelocytic leukemia developed persistent fever after successful induction-remis-

sion therapy; many large monilial abscesses were later found in the grossly enlarged spleen. Although the technetium/sup 99M/-sulfur colloid scan prior to splenectomy suggested only a slight abnormality of the spleen, the gallium-67 citrate scintigraph showed a marked increase in gallium accumulation. The disparate results of the scanning techniques utilized in this patient suggest that it may be necessary to use more than one type of radiopharmaceutical to define an enlarged spleen, as well as the pathological process responsible for its enlargement. (auth)

29864 EFFECT OF CALLUS FORMATION AND GROWTH REGULATORS ON $^{14}CO_2$-UPTAKE OF CITRUS LEAVES. Hoffmann, E.; Lenz, F. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Nutzpflanzenforschung). Gartenbauwissenschaft; 40: No. 1, 35-36(1975).

1 tab.; 13 refs.

Cuttings of Citrus limon, consisting of a lamina, petiole, axillary bud and a 2 cm piece of stem with or without callus at the base were for five hours dipped with the stem into the following hormone solutions: GA_3 (100 ppM); IAA (50 ppM); Kinetin (50 ppM); GA_3 + IAA + Kinetin (100 + 50 + 50 ppM). The hormone treatments and the callus formation stimulated the $^{14}CO_2$ uptake of the leaves. In cuttings having no callus the combined application of three hormones was most effective in promoting $^{14}CO_2$ uptake while in the cuttings with callus $^{14}CO_2$ uptake was favored particularly by Kinetin. (DE)

29865 SPECIFIC DEUTERIUM LABELLING AND COMPUTERIZED GAS CHROMATOGRAPHY. Mass Spectrometry in Studies on the Metabolism in Vivo of a Steroid Sulphate in the Rat. Baillie, T. A.; Eriksson, H.; Herz, J. E.; Sjoevall, J. (Kungliga Karolinska Mediko-Kirurgiska Institutet, Stockholm (Sweden). Kemiska Institutionen). Eur. J. Biochem.; 55: No. 1, 157-165(Jun 1975).

5 figs.; 33 refs.

The metabolism of 3β-hydroxy-5α-pregnan-20-one sulphate was studied in bile fistula rats and in isolated perfused livers. Computerized gas chromatography-mass spectrometry, in combination with specific deuterium labelling, was employed to follow the metabolic transformations. The major metabolic pathway in male rats involved the steps: hydrolysis, 2α-hydroxylation, oxidoreduction at C-3 and glucuronide conjugation, yielding 2α,3α-dihydroxy-5α-pregnan-20-one glucuronide as the major metabolite. Only traces of the injected steroid sulphate were detected in bile from male animals. In contrast, the administered compound was the major steroid excreted in bile of female rats, where the main metabolite was identified as 3β,15β-dihydroxy-5α-pregnan-20-one sulphate. (DE)

29866 AUTORADIOGRAPHIC STUDIES OF THE KIDNEYS OF HAMSTERS BEARING LONGTERM OESTROGEN IMPLANTS. Pantic, V. (Institut za Bioloska Istrazivanja, Belgrade (Yugoslavia)); Li, J.; Villee, C. (Harvard Medical School, Boston, Mass. (USA). Lab. of Human Reproduction and Reproductive Biology). Cytobiologie; 9: No. 2, 89-99(Aug 1974).

8 figs.; 12 refs.

The ability of kidney cells to incorporate tritiated estradiol, thymidine, or uridine was investigated in hamsters with estrogen implants for more than six months and in corresponding control hamsters without implants. Using autoradiography the following results were obtained: The cells of some proportion of the proximal convoluted tubules showed an increased ability to incorporate tritiated estradiol, thymidine, and uridine. Many of these cells were able to transport the labeled estrogen-receptor complex into the nuclei within 45 minutes after the administration of labeled estradiol. The cells of the distal convoluted tubules were labeled but generally to a much smaller extent. Only some individual cells showed a tendency for an increased accumulation of estradiol. The cytoplasm of cells in the loop of Henle seems to be covered uniformly with silver grains in both control and estrogen treated hamsters. The cells of collecting and papillary duct tubules located in the medullary rays do not show any tendency for an increased uptake of labeled estradiol. (DE)

29867 THE EFFECT OF INSULIN ON AMINO ACID INCORPORATION INTO EXOCRINE PANCREATIC CELLS OF THE RAT. Kramer, M. F.; Poort, C. (Rijksuniversiteit Utrecht (Netherlands). Lab. voor Histologie en Celbiologie). Horm. Metab. Res.; 7: No. 5, 389-393(Sep 1975).

3 tabs. with refs.

The rate of incorporation of radioactive leucine per cell in the acinar pancreatic cells of the rat increases by 50% within one hour after subcutaneous administration of insulin, an effect that lasts for at least one more hour. The rate of incorporation has been measured by quantitative radioautography and by determination of the radioactivity per μg DNA in TCA-precipitable material from tissue homogenates. The capacity for amino acid (leucine and lysine) incorporation as measured by incubating pancreatic fragments in vitro is not enhanced by insulin treatment of the rat in vivo during one or more hours. Insulin was found to lower the serum concentration of most amino acids significantly, leucine by 50%. The apparent effect of insulin on the incorporation of radioactive leucine in vivo can be explained by the difference in the specific radioactivity of the circulating amino acid in the treated rats as compared to the untreated ones. A change in amino acid concentration in the serum may likewise be the explanation of the decrease in amino acid incorporation rate in alloxan diabetic rats. (DE)

29868 RADIONUCLIDES FOR ROUTINE DIAGNOSTICS IN NUCLEAR MEDICINE. Kampmann, H.; Adam, W. E. (Ulm Univ. (F. R. Germany). Dept. Radiologie). Roentgenpraxis; 28: No. 6, 142-152(Jun 1975). (In German)

4 figs.; 3 tabs.; 16 refs.

A survey is given on the radiopharmaceutics which are now in common use in nuclear medical diagnostics in vivo and in vitro. The development of radiopharmacology in the last 20 years has been characterized by the production of new and better radionuclides. A great step forward in clinical nuclear medicine has been the introduction of radionuclide generators for the production of short-lived nuclides. The most important and most generally used radionuclide for in vivo examinations is ^{99m}Tc pertechnetate. Tumor specific substances are still unknown, while the radioactive in vitro tests are of great clinical importance. They have opened up new possibilities of clinical laboratory diagnostics which are still not fully exploited. Special mention is made of the thyroid-specific in vitro tests in radiological thyroid diagnostics. (DE)

29869 TRANSLATIONAL STEP INHIBITED IN VIVO BY AFLATOXIN B_1 IN RAT-LIVER POLYSOMES. Sarasin, A.; Moule, Y. (Centre National de la Recherche Scientifique, 94-Villejuif (France). Inst. de Recherches Scientifiques sur le Cancer). Eur. J. Biochem.; 54: No. 2, 329-340(Jun 1975).

4 figs.; 7 tabs.; 52 refs.

Aflatoxin B_1 strongly inhibits protein synthesis in rat liver cells. This paper confirms the foregoing results and represents an attempt to localize the translational step inhibited in vivo by aflatoxin B_1. We used the simulation study developed by Li, Kisilevsky, Wasan and Hammond, 1972 (Biochim. Biophys. Acta, 272, 451-462) to determine precisely the site inhibited in vivo after drug intoxication. This analysis is based on two parameters: the kinetics of polysome labeling to follow the nascent peptide synthesis, and the kinetics of supernatant labeling to follow the completed protein synthesis. Up to 5 h after dosing, aflatoxin specifically inhibits the elongation and/or termination steps during protein synthesis; after longer periods of time inhibition occurs essentially at the initiation step. When the intracellular concentration of aflatoxin is too high, particularly 2 h after dosing, each step of protein synthesis is blocked. Polypeptide synthesis by the postmitochondrial supernatants isolated from aflatoxin-treated animals is impaired in the same proportion as protein synthesis in vivo. The damage caused by aflatoxin is mostly observed on microsomes. However, purified polysomes isolated from aflatoxin-treated rats synthesize proteins in vitro to the same extent as those from controls. These results suggest that aflatoxin metabolite(s) are bound to polysomes with noncovalent bonds. These active metabolites are probably lost during polysome isolation procedures. Finally, relationships between protein metabolism and aflatoxin carcinogenesis are discussed. (DE)

29870 STUDIES ON IN VIVO INCORPORATION OF ^{14}C-ACETATE AND ^{14}C-MEVALONATE INTO CHOLESTEROL IN THE LIVER OF RAT INTOXICATED WITH CARBON DISULPHIDE. Wronska-Nofer, T. (Instytut Medycyny Pracy w Przemysle Wlokienniczym i Chemicznym, Lodz (Poland). Zakiad Biochemii). Int. Arch. Arbeitsmed. 34: No. 3, 221-229(1975).

2 figs.; 3 tabs.; 20 refs.

As an extension of former results, which testified that intoxication with CS_2 raises the biosynthesis of cholesterol in the liver, the aim of this experiment was to investigate the dynamics of incorporation of the ^{14}C-acetate into cholesterol in the liver of rats exposed to CS_2, and to determine which step of cholesterol biosynthesis is accelerated with CS_2. The studies of incorporation of ^{14}C-acetate and ^{14}C-mevalonate into liver cholesterol were carried out in vivo, in the control and CS_2 intoxicated rats (concentration 1.5 mg/l, over 7 months) at various times after a single injection of ^{14}C-acetate or ^{14}C-mevalonate. The results of the experiment indicated that exposure of rats to CS_2 causes: (1) increase in the specific radioactivity of liver cholesterol both after ^{14}C-acetate and ^{14}C-mevalonate injection, but incorporation of cholesterol precursors proceeds faster with acetate than with mevalonate; (2) no changes in the cholesterol concentration in the liver and in the liver weight; (3) faster increase and decline of specific activity of cholesterol in the liver; (4) increase in the specific radioactivity of cholesterol in the serum corresponding to the changes observed in the liver. (DE)

29871 RADIOISOTOPE IMAGING: THE END OF THE BEGINNING. Mallard, J. (Univ. of Aberdeen, Scotland). Arq. Patol. (Lisbon); 46: No. 1, 3-26(Apr 1974).

From symposium of nuclear medicine in oncology; Lisbon, Portugal (27 Apr 1973).

The author maintains that the period of exploration in radioisotope scanning is over. This is evidenced by two facts; much more is understood about isotope imaging and techniques are becoming more complex in order to achieve special purposes. (ERB)

29872 RADIOISOTOPIC STUDIES OF THE REGINAL MYOCARDIAL CIRCULATION. Cannon, P. J. Circulation; 51: No. 6, 955-963(Jun 1975).

The rationale for radioisotopic studies of regional myocardial blood flow is discussed. Among the topics included in the discussion are: the limitations of coronary arteriography; noninvasive screening for ischemic heart disease; radioisotope diagnosis of myocardial infarction; measurement of coronary blood flow; measurement of regional myocardial perfusion; ^{133}Xe washout studies; and clinical problems. (ERB)

29873 RADIOIMMUNOASSAY OF PLASMA 11-DESOXYCORTICOSTERONE. Manlimos, F. S.; Maroulis, G. B.; Abraham, G. E. (Harbor General Hospital Campus, Torrance, CA). Anal. Lett.; 8: No. 12, 931-938(Dec 1975).

This report describes a radioimmunoassay method for the measurement of unconjugated 11-desoxycorticosterone (DOC) in plasma. Utilizing an anti-DOC antiserum cross reacting minimally with the steroids tested, combined with a one step celite microcolumn chromatography, we have measured this steroid accurately in aliquots of plasma for premenopausal female subjects. The plasma levels of DOC obtained by this method agreed well with levels observed in adult women, using other technics. During the four menstrual cycles studied, DOC levels were significantly higher in the luteal phases compared to the follicular phases in all four subjects. (auth)

29874 THYROID SCINTIGRAM: SENSITIVITY WITH SODIUM PERTECHNETATE /SUP 99m/Tc AND GAMMA CAMERA WITH PINHOLE COLLIMATOR. Ryo, U. Y.; Arnold, J.; Colman, M.; Arnold, M.; Favus, M.; Frohman, L.; Schneider, A.; Stachura, M.; Pinsky, S. (Michael Reese Hospital, Chicago). J. Am. Med. Assoc.; 235: No. 12, 1235-1238(22 Mar 1976).

To evaluate the reliability of thyroid scintigraphy in the diagnosis of nodular growths, scintigrams of patients who later underwent thyroidectomy were reviewed and correlated with pathologic findings. The scintigrams were all obtained with a 5-mm single-hole collimator-equipped gamma-scintillation camera after intravenous injection of 5 millicuries of sodium pertechnetate Tc/sup 99m/. In the group of 92 patients, six of whom had two histologically different lesions, 149 nodules were identified pathologically. There were 26 nodules 2 to 5 mm in diameter, of which 22 were benign and four were malignant. None of the 22 benign nodules were delineated scintigraphically. Superior image quality and resolution, low radiation dose, technical simplicity, and speed make /sup 99m/Tc pinhole-camera scintigraphy the best procedure available for routine thyroid imaging. (auth)

29875 RADIOIMMUNOASSAY OF HUMAN PROPARATHYROID HORMONE: ANALYSIS OF HORMONE CONTENT IN TISSUE EXTRACTS AND IN PLASMA. Habener, J. F.; Stevens, T. D.; Tregear, G. W.; Potts, J. T. Jr. (Massachusetts General Hospital, Boston). J. Clin. Endocrinol. Metab.; 42: No. 3, 520-530(Mar 1976).

A radioimmunoassay for human proparathyroid hormone (hProPTH) has been developed and applied to an evaluation of prohormone content in parathyroid tissues and in plasma. Antisera were produced in rabbits by immunization with a synthetic octadecapeptide fragment of bovine ProPTH (bProPTH). A synthetic analogue of the prohormone peptide fragment containing tyrosine was used as the radioiodinated tracer, and a synthetic prohormone peptide consisting of the first 40 amino acids of hProPTH was used as the assay standard. The immunological activity of synthetic hProPTH peptide was unstable in plasma and buffers containing plasma or serum, but degradation was prevented by using heat-inactivated serum and EDTA in the assay solutions. The sensitivity of the assay for detection of hProPTH peptides (0.2 ng) was 5,000-times greater than for the detection of cross-reacting parathyroid hormone (PTH) peptides (1 mu g), and the prohormone-specific hexapeptide did not react in the assay. The amounts of ProPTH in extracts of freshly-collected human parathyroid adenomas and in extracts of bovine parathyroid glands were 0.35 +- 0.13 and 0.38 +- 0.13 mu g/mg protein, respectively, whereas the amounts of ProPTH in extracts of adenomas stored for up to a year before extraction and in extracts of human parathyroid glands obtained at autopsy were approximately ten times less than in freshly collected and extracted tissues. (auth)

29876 DYNAMIC SCINTIGRAPHY IN DIAGNOSIS OF ANEURYSM AND ARTERIOSINUS ANASTOMOSES OF THE CEREBRAL VESSELS. Badmaev, K. N.; Rameshvili, T. E.; Svetlova, N. L.; Khil'ko, V. A. Med. Radiol.; 20: No. 11, 31-35(1975). (In Russian).

The authors analyzed the data on scintigraphy and angiography of 34 patients suspected of cerebral vessels aneurysm (arteriovenous aneurysm was suspected in 18, arterial aneurysm in 3, carotid-cavernous anastomosis in 3, intracerebral hematoma in 3). Lesser traumatism, relative simplicity, lesser radiation load in angiography, possibility of visualization of aneurysm glomus with afferent and efferent vessels, detection of hematoma after aneurysm rupture in the acute period, possibility of differential diagnosis in arterio-venous aneurysm and tumors of membrano-vascular nature—all this allows one to recommend dynamic scintigraphy for a wider use in diagnostic practice prior to purposeful contrast roentgenological studies. (auth)

29877 SCANNING OF THE LIVER WITH LABELED COLLOID SOLUTION AND METHIONINE. Palinkashi, D. G.; Prokubovsky, V. I. (Moscow Medical Inst.). Med. Radiol.; 20: No. 11, 35-39 (1975). (In Russian)

A total of 58 patients with affection of the liver (tumors, cirrhosis, echinococcus) underwent scanning with methionine ^{75}Se and colloid solution ^{198}Au. It was shown that the diagnostical efficacy of scanning of the liver with methionine was considerably higher than during its investigation by colloid solutions: when using methionine ^{75}Se the pathology was revealed in all the cases and when scanning with a colloid solution ^{198}Au it was observed in 41.2 percent of patients with tumors and only in 19.0 percent of the patients with cirrhosis. The results of scanning of the mentioned patients were compared with the results of celiacography, laparotomy, and biopsy. According to the authors' opinion the scanning of the liver with methionine ^{75}Se opens up principally new possibilities of its investigation from the point of view of reflection in vivo of metabolic processes in hepatic parenchyma. (auth)

29878 EXPEDIENCY OF COMBINATION OF RADIOISOTOPE AND ULTRASONIC DIAGNOSIS. Muratkhodzhaev, N. K.; Fazylov, A. A.; Karimova, S. B.; Khadzhibekov, M. Kh. Med. Radiol.; 20: No. 11, 39-44(1975). (In Russian).

The authors showed that by combining the radioisotope scanning with ultrasonic investigation in diagnosis of the diseases of the thyroid gland, liver, and kidneys, it was possible to considerably expand the volume of the diagnostical information at the expense of the resolving power improvement, specifying the depth of the destruction foci and their microstructure. The article substantiates the expediency of a complex radioisotope and ultrasonic diagnosis in unity. (auth)

29879 EVALUATION OF ^{198}Au-LABELLED COLLOIDS WITH DIFFERENT DISPERSIVITY DURING RADIOISOTOPIC LYMPHOGRAPHY. Laricheva, I. P.; Chistova, L. K. (Moscow Regional Scientific and Research Inst. of Obstetrics and Gynecology). Med. Radiol.; 20: No. 11, 76-78(1975). (In Russian).

Preparations of polydisperse colloids have inhomogeneous dimensions of the particles in different formulations which leads to their non-uniform accumulation in different groups of lymphatic nodes and to a decrease of the quality of the scanning images. Small-disperse colloidal solutions have a significant preference over polydisperse preparations. Their use makes it possible to obtain a good quality scan of all groups of lymphatic nodes. (tr-auth)

29880 JOINT SCINTIGRAPHY WITH ^{99m}Tc-PYROPHOSPHATE. Mirtl, B.; Leb, G.; Klein, G.; Goebel, R.; Eber, O. (Graz Univ. (Austria). Medizinische Klinik). Z. Rheumatol.; 34: No. 5, 149-154(May 1975). (In German)

Joint scintigraphy was performed in 85 patients suffering from a variety of rheumatic diseases, using a gamma camera and line scanner. Tc-pyrophosphate was the radionuclide employed; it accumulates selectively in the juxta-articular parts of the bone. The method provides an objective demonstration of inflammatory and degenerative rheumatic joint changes. Moreover, scintigraphic changes can be demonstrated in joint disease which is too early to be clinically apparent or before there are any corresponding changes in serological parameters. The method is useful both in the localization and staging of disease, in the evaluation of treatment and as an objective control of clinical skills. (DE)

29881 CEREBRAL BLOOD FLOW (MEASURED BY MEANS OF ISOTOPES) AND BASE-ACID-EQUILIBRIUM OF THE CSF IN MIGRAINE. Saurugg, D. (Landesnervenkrankenhaus Valduna, Rankweil (Austria). Neurologische Abt.); Schnaberth, G. (Vienna Univ. (Austria). Neurologische Klinik). Muench. Med. Wochenschr.; 117: No. 38, 1511-1512(Sep 1975). (In German).

In migraine patients a considerable metabolic disturbance characterised by a decrease in bicarbonate and an increase in

lactate was demonstrated during the migrainous status. Measurements of the cerebral circulation were taken by means of radioactive isotopes and showed a distinct decrease in blood supply to the entire brain during the migraine attack. Following forced hyperventilation during the attack-free interval a pathological reactivity with decreased blood flow was found in the hemisphere which has been indicated as the usual site of the migrainous pain. (DE)

29882 "FALSE POSITIVE" SCAN FOR MECKEL DIVERTICULUM. Rodgers, B. M. (Univ. of Florida, Gainesville); Youssef, S. Pediatrics; 87: No. 2, 239-240(Aug 1975).

As the clinical usage of technetium 99/sup m/ to aid in the diagnosis of bleeding from a Meckel diverticulum has increased in the past four years, various conditions have arisen in which "false positive" Meckel scans have been obtained. A recent case illustrates one of these conditions and suggests a possible further use for this diagnostic procedure. (auth)

29883 USE OF RADIONUCLIDE IMAGING IN THE EARLY DIAGNOSIS AND TREATMENT OF RENAL ALLOGRAFT REJECTION. Mandel, S. R.; Mattern, W. D.; Staab, E.; Johnson, G. Jr. (Univ. of North Carolina, Chapel Hill). Ann. Surg.; 181: No. 5, 596-603(May 1975).

From annual meeting of the Southern Surgical Association; Boca Raton, Florida (USA). (9 Dec 1975).

Data are presented on the clinical application of radionuclide imaging to evaluate changes in cadaver transplant function in the immediate postoperative period. The method uses orthoiodohippuric acid (hippuran) administered IV, with scintillation imaging, and curve analysis by a digital computer. An initial study is always obtained 24 hours after transplantation. Serial studies are then obtained, as needed, to interpret the clinical course. Selected cases are presented which illustrate the use of this protocol in various clinical settings. In the oliguric patient serial studies have been of particular value. They have identified ATN so that overenthusiastic treatment for rejection could be avoided. They have also identified acute rejection complicating ATN so that high dose steroid therapy could be administered appropriately. In the nonoliguric patient they have frequently contributed to the early diagnosis of acute rejection, and they have been useful in monitoring the effect and duration of treatment for severe rejection crisis. It is concluded that radionuclide imaging studies, when carefully applied and interpreted, are a valuable adjunct to the management of patients in this complex clinical setting. (auth)

29884 SIMPLIFIED DIRECT RADIOIMMUNOASSAY METHOD FOR MEASURING CARCINOEMBRYONIC ANTIGEN. Smith, H. J.; Figard, P. H.; Goekcen, M. (Life Sciences Foundation, Minneapolis). Res. Commun. Chem. Pathol. Pharmacol.; 11: No. 1, 107-115(May 1975).

The radioimmunoassay for carcinoembryonic antigen as usually carried out is an involved, time-consuming procedure complicated by the use of a dialysis step to remove perchloric acid from an extract of the sample. A simplified direct assay for the antigen in serum or plasma is reported here. It is evaluated in comparison with our earlier method which was done using perchloric acid extraction of the samples. The results of the simplified method compare favorably with those of the indirect method. (auth)

29885 INFLAMMATORY LESIONS LOCALIZED WITH /sup 99m/Tc-LABELED LEUKOCYTES. Andersen, B. R.; English, D.; Akalin, H. E.; Henderson, W. (Univ. of Illinois, Chicago). Arch. Intern. Med.; 135: No. 8, 1067-1071(Aug 1975).

Canine leukocytes were labeled with a gamma-ray emitting isotope by permitting them to phagocytize technetium /sup 99m/Tc sulfur colloid particles in vitro and removing the unphagocytized particles by washing the cells. The labeled cells were reinfused intravenously into the donor dogs. Scintigraphic scans were performed 4 and 24 hours following the leukocyte infusion. In animals with sterile and infected intramuscular abscesses and pulmonary infections, it was possible to localize the lesions by scintigraphic scanning four hours following administration of labeled leukocytes. In one experiment, a positive scan was observed 24 hours after the leukocyte infusion. It was also shown that labeled leukocytes tend to concentrate in abscess fluid. These results suggest that technetium /sup 99m/Tc sulfur colloid-labeled leukocytes may be a useful diagnostic tool in localizing abscesses and inflammatory lesions in humans. (auth)

29886 INTESTINAL BLOOD FLOW. An Evaluation by Clearance of ^{133}Xe From The Canine Jejunum. Wilson, S. E. (Wadsworth Hospital Center, Los Angeles); Hiatt, J.; Winston, M.; Passaro, E. Jr. Arch. Surg. (Chicago); 110: No. 7, 797-801 (Jul 1975).

Clearance of a parenchymal injection of xenon ^{133}Xe from the jejunum was used to assess changes in tissue perfusion produced by variations in superior mesenteric artery flow resulting from partial aortic occlusion. Disappearance of xenon from submucosa and muscularis was similar and reproducible. The biexponential function of the isotope clearance exhibited a rapid initial component representing mean flow. Calculated xenon clearance rates, expressed as half-times for isotope disappearance and plotted as a function of decreasing superior mesenteric artery flow, were characteristically rapid for a broad range of superior mesenteric artery flows (90 to 600 ml/min). With reduction of superior mesenteric artery flow beyond 10 +- 10 ml/min, tissue clearance of xenon was markedly prolonged. Adequate perfusion of the vascular compartments of the small bowel as measured by xenon clearance was maintained until 80 percent reduction of superior mesenteric artery flow. (auth)

29887 NOTE ON THE DETERMINATION OF SPECIFIC ACTIVITY OF ^{32}P FOR THE STUDY OF ROOT DISTRIBUTION IN SOIL-ROOT CORES. Maurya, P. R.; Ghildyal, B. P.; Sharma, D. (Govind Ballabh Plant University of Agriculture and Technology, Pantnagar (India)). Indian J. Agric. Sci.; 43: No. 9, 886-887 (Sep 1973).

A rapid and suitable method for the determination of specific activity of ^{32}P for the study of root distribution in soil-root cores is investigated. Soil-ignition method, triacid digestion method and root washing method are studied. It is observed that the results of the percentage of root distribution by the triacid digestion method are closer to the values obtained by the root-washing procedure.

29888 ENVIRONMENTAL REGULATION OF INFORMATION FLOW. Mitra, B.; Das, J.; Sen, S. P. (Kalyani Univ. (India). Dept. of Botany). Indian J. Plant Physiol.; 14: No. 1, 5-17(1971).

From international seminar on physiology of differentiation in plants; Simla, India (17 May 1971). 21 refs., 15 tables.

The effect of temperature, light and chemical environment of the cell on synthesis of nucleic acid and protein has been investigated in Xanthium brittoni, Parbitis nil, Glycine max cv. Biloxi, Oryza sativa cv. Rupsail, Hordeum vulgare cv. Wintex, and Pisum sativum cv. Alaska. To study nucleic acid synthesis, leaf sections, buds and coleoptiles were fed with orthophosphate-^{32}P or adenine-8-^{14}C or uracil-2-^{14}C for specified periods. To study protein synthesis, two ^{14}C-labelled amino acids were used individually or together. Results indicate that changes in the environment cause alteration in the flow of information from the genetic material.

29889 STUDIES ON THE PRIMARY PHLOEM OF GOMPHOCARPUS PHYSOCARPUS. Botha, C. E. J. Pietermaritzburg South Africa; Natal Univ. (1974). 99p. INIS.

Thesis.

Penetration of the stems and leaves of Gomphocarpus physocarpus by the aphid, Aphis nerii, was studied with light and phase microscopes. Penetration of the epidermis and ground tissue was largely intercellular, that of the phloem tissues partly intercellular and in part intracellular. Of 75 pairs of stylet tips encountered in presumably functional sieve tubes 73 were lodged in sieve tubes of the internal and adaxial phloem. Light and electron microscope investigation of the ontogeny and differentiation of the primary phloem revealed that the internal and adaxial phloem attains a more advanced stage of maturity earlier than the corresponding external and abaxial strands. Furthermore, the protoadaxial phloem sieve tubes remain functional throughout the primary stages of growth, whereas the corresponding abaxial phloem sieve plates are associated with massive deposits of definitive callose during the latter stages of primary growth. The internal and adaxial phloem was found to be capable of independent assimilate translocation in plants which had the external phloem experimentally ringbarked. Translocation in the internal and adaxial phloem of such plants was unaffected by ringbarking. The results are interpreted as indicating that a greater proportion of assimilates is translocated in the internal and adaxial phloem sieve tubes than in the external and abaxial sieve tubes. It is concluded that this governs A. nerii's preference for the internal and adaxial phloem as a prime feeding site.

29890 9,10-DIHYDROERGOTAMINE: PRODUCTION OF ANTIBODIES AND RADIOIMMUNOASSAY. Rosenthaler, J.; Munzer, H. (Sandoz Ltd., Basel). Experientia; 32: No. 2, 234-236(15 Feb 1976).

Antibodies against 9, 10-dihydroergotamine (DHE) were produced by immunizing rabbits with a conjugate of 6-nor-6-carboxymethyl-9,10-dihydroergotamine and bovine serum albumin. A highly specific and sensitive radioimmunoassay for DHE has been developed. (auth)

29891 THE RELATIONSHIP BETWEEN DNA SYNTHESIS AND INCORPORATION OF (^{14}C) LYSINE INTO DIFFERENT HISTONE FRACTIONS IN EHRLICH ASCITES TUMOUR CELLS. Malec, J.; Kornacka, L.; Wojnarowska, M.; Moscicka, M. (Instytut Hematologii, Warsaw (Poland)). Acta Biochim. Pol.; 21: No. 1, 101-106(1974).

The effect of inhibition of DNA synthesis by hydroxyurea on (^{14}C) lysine incorporation into the main four histone fractions in Ehrlich ascites tumor cells, was examined in vitro. The radioactivity of lysine-rich histones, especially of histone f1, was preferentially decreased. The smallest decrease was observed for histone f3. The incorporation into other cellular proteins was but slightly affected. (auth)

29892 COMPARATIVE DETERMINATION OF TOTAL SERUM THYROXINE. Bieler, E. U.; De Bruin, E. J. P. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Life Sciences Div.); Nagel, D. S. Afr. Med. J.; 49: 712-714(19 Apr 1975).

The precision, accuracy, sensitivity and clinical results of a radio-immunological method for the determination of total serum thyroxine are compared with similar criteria of a competitive protein-binding assay. Application of both methods in the assay of thyroxine in 150 serum samples gave good agreement between the two techniques. The radio-immunoassay offers certain methodological advantages and is considerably less costly than thyroxine determinations in which commercially available kits are used. (INIS)

29893 RADIOIMMUNOLOGIC METHOD OF DETERMINATION OF THE CHORIONIC GONADOTROPIN. Kosowicz, J.; Skalba, P. (Akademia Medyczna, Poznan (Poland); Slaska Akademia Medyczna, Katowice (Poland)). Ginekol. Pol.; 45: No. 6, 677-682(1974). (In Polish).

The paper presents a rapid and simple technique of radioimmunologic estimation of the chorionic gonadotropin. The anti-HCG antibodies were obtained in the rabbits, inoculated several times with 1 mg of chorionic gonadotropin with the addition of complete Freund's adjuvant. The sera from two rabbits —with high anti-HCG (titer 1:1,600,000 and 1:2,500,000) were used for the coating of polystyrene tubes in carbonate buffer (pH 9.5 to 10.5) in a 1:5,000 dilution. Iodine labelling was done using chloramine technique and utilizing highly purified HCG-13,000 units per milligram. The estimations were performed using iodine labelled ^{125}I-HCG with proper activity of 100 to 150 mCi per mg. The duration of testing was shortened to 3 hours. In order to determine the clinical value of this technique, 810 determinations of HCG were performed in serum and urine samples collected from 30 nonpregnant women and from 120 women in different gestational periods. The results corresponded to those obtained by other techniques. (auth)

29894 RADIOIMMUNOLOGICAL ASSESSMENT OF PARATHYROID HORMONE. Kosowicz, J. (Akademia Medyczna, Poznan (Poland)). Pol. Arch. Med. Wewn.; 51: No. 3, 281-290 (1974). (In Polish).

Methodological details of determination of parathyroid hormone (PTH) in serum extracts were elaborated and the usefulness of this method in clinical practice was assessed. Parathyroid hormone was iodinated by the chloramine method adsorbing PTH on QUSO G-32 silica, then the hormone was purified additionally on a Sephadex G-100 column and CM C-25 cation exchanger. The usefulness of various adsorbents for preparation of PTH extracts of serum was tested. The best results were obtained with QUSO G-32 silica, Spherosil A, and particularly, with CPG-10 Å-75 glass powder. In the obtained extracts PTH was determined by the double-antibody technique. Significantly raised levels of PTH in the serum (2-12 ng/ml) were observed in cases of primary hyperparathyroidism and in chronic renal failure. In healthy subjects the PTH concentration in the serum was undetectable or within limits from 0.4 to 1.0 ng/ml. (auth)

29895 TRI-IODOTHYRONINE RADIOIMMUNOASSAY IN HYPOTHYROIDISM AND HYPERTHYROIDISM. Kosowicz, J.; Nauman, J.; Nauman, A. (Akademia Medyczna, Poznan (Poland); Centrum Medyczne Ksztalcenia Podyplomowego, Warsaw (Poland)). Pol. Tyg. Lek.; 29: No. 14, 557-559(1974). (In Polish).

Radioimmunoassays of serum tri-iodothyronine (T_3) by double antibody technique were performed in 27 cases of hypothyroidism, in 46 cases of hyperthyroidism and in a control group of 29 subjects. In control subjects serum T_3 concentration was 130 to 190 nanograms 100 ml. In all patients with hypothyroidism serum T_3 was lowered in the range of 10 to 80 ng/100 ml, while in hyperthyroidism it was raised ranging from 290 to 1600 ng/100 ml. The radioimmunoassay of serum T_3 is more reliable than other tests of thyroid function and deserves a more widespread use in the diagnosis of thyroid disease. (auth)

29896 RESULTS OF TSH RADIOIMMUNOASSAYS IN HYPOTHYROIDISM. Kosowicz, J.; Gembicki, M. (Akademia Medyczna, Poznan (Poland)). Pol. Tyg. Lek.; 29: No. 15, 597-599(1974). (In Polish).

Radioimmunoassays of serum thyrotropic hormone (TSH) concentration by double antibody technique were performed in 26 cases of hypothyroidism, 27 control subjects, 22 cases of hyperthyroidism and 8 cases of hypopituitarism. In all control subjects, in patients with hyperthyroidism and hypopituitarism serum TSH concentration was low in the range of 0 to 4 μm/ml. On the other hand, in all cases of hypothyroidism serum TSH was definitely increased and amounted to 25 to 500 μU/ml. Comparative studies of TSH assay with other thyroid function tests reveal that TSH assay is the most sensitive index of thyroid hypofunction which allows a proper diagnosis of hypothyroidism in early stages of the disease. (auth)

29897 DETECTION OF HEPATITIS B ANTIBODIES BY MEANS OF RADIOIMMUNOELECTROPRECIPITATION. Madalinski, K.; Gajewski, A. K.; Walicka, B. (Panstwowy Zaklad Higieny, Warsaw (Poland)). Pol. Arch. Med. Wewn.; 51: No. 5, 477-483(1974). (In Polish).

For detection of antibodies to hepatitis B antigen (HBAg) in the serum the authors used the method of radioimmunoelectroprecipitation with HBAg labelled with radioactive iodine. In the tested sera from patients with viral hepatitis in the first 4 weeks of the disease, presence of antibodies to HBAg was established in 16 out of 25 patients (64%). The method gives a possibility of quantitative presentation of its results, moreover it is nearly 50 times more sensitive than the usual method of immunoelectroprecipitation. (auth)

29898 LOSS OF ^{51}Cr-ALBUMIN INTO THE DIGESTIVE TRACT IN PATIENTS WITH ULCERATIVE COLITIS. Tkaczewski, W.; Stempien, R.; Niedzielska, H.; Kuydowicz, J. (Wojskowa Akademia Medyczna, Lodz (Poland)). Pol. Tyg. Lek.; 29: No. 25, 1065-1066(1974). (In Polish).

Investigations were carried out in 24 patients with ulcerative colitis, with 14 patients in the active phase and 10 in remission. ^{51}Cr-albumin was used for evaluation of protein loss, the labelled albumin being injected intravenously in a dose of 40 μCi, and the radioactivity of 24-hour stools was determined during 4 days. It was found that protein loss into the digestive tract is increased in the active phase and normal during remission. In the light of this observation it is suggested that the isotope method of determination of protein loss may be used as a convenient clinical test evaluation of the dynamics of ulcerative colitis. (auth)

29899 EXPERIMENTAL INVESTIGATIONS ON ISOTOPE DIAGNOSIS OF MYOCARDIAL INFARCTION. Zmudzinski, J.; Kusmierski, S.; Sorek, G. (Slaska Akademia Medyczna, Katowice (Poland)). Pol. Tyg. Lek.; 29: No. 16, 657-659(1974). (In Polish).

In view of favorable opinions on the clinical value of isotope techniques in the diagnosis of myocardial infarction the authors tried to localize more precisely the appearance of radioactivity after administration of ^{131}I in the cardiac area in dogs with surgically induced myocardial infarction. The experiments were carried out on 15 dogs with 5 dogs in the control group, while in 10 animals myocardial infarction was induced. It was found that the rise in the radioactivity in the cardiac area is not connected directly with myocardial necrosis but with high concentration of the isotope in the walls and the content of the stomach when emptying of the stomach is disturbed. (auth)

29900 RADIOIMMUNOASSAY METHOD FOR TRIIODOTHYRONINE AND THYROXINE. Hollander, C. S. (to New York Univ.). US Patent 3,928,553. A61K43/00; G01T33/00; G01T1/16; G21H5/02. 23 Dec 1975. Filed Date 25 Feb 1974. 10p. PAT-APPL-445,115.

This invention relates to a radioimmunoassay method for triiodothyronine or thyroxine or triiodothyronine and thyroxine present in unextracted serum containing thyroxine binding prealbumin and thyroxine binding globulin. Procedures using ^{125}I and ^{131}I are described.

29901 TECHNETIUM STANNOUS PYROPHOSPHATE MYOCARDIAL SCINTIGRAMS IN PATIENTS WITH CHEST PAIN OF VARYING ETIOLOGY. Willerson, J. T.; Parkey, R. W.; Bonte, F. J.; Meyer, S. L.; Atkins, J. M.; Stokely, E. M. (Univ. of Texas, Austin). Circulation; 51: No. 6, 1046-1052(Jun 1975).

Technetium-99m stannous pyrophosphate was utilized for myocardial imaging in 202 patients admitted to the hospital with chest pain of uncertain etiology. One hundred and one patients had clinical and evolved electrocardiographic and enzymatic evidence of acute myocardial infarction. Ninety-six of these 101 patients had increased myocardial uptake of the technetium stannous pyrophosphate and positive myocardial scintigrams; there was nearly precise correlation between the ECG and myocardial imaging localization of the area of infarction for acute transmural myocardial infarctions. In the five patients with negative myocardial images the scintigrams were obtained after seven or more days had elapsed following the myocardial infarction. In the remaining 101 patients no clinical, ECG, or enzymatic evidence of infarction developed; 92 of these patients had negative myocardial scintigrams. Seven of the remaining nine patients were admitted with "unstable angina pectoris" and despite the absence

of diagnostic ECG and enzyme evolution each of these patients had faintly and diffusely positive myocardial scintigrams. The remaining two patients had positive myocardial scintigrams but no definite ECG or enzymatic evidence of acute myocardial infarction. Thus the technetium pyrophosphate imaging technique appears safe, inexpensive and to correlate well with ECG and enzyme identification of the presence of infarction and with ECG localization of myocardial infarction. In addition the positive myocardial scintigrams in some patients with unstable angina suggest that there may be limited myocardial necrosis that is ordinarily undetected by ECG and enzymes in these patients. The incidence of false positive and false negative scintigrams appears to be small. (auth)

29902 BONE MARROW SCANNING WITH ^{52}Fe. Regeneration and Extension of Marrow After Ablative Doses of Radiotherapy. Knospe, W. H.; Rayudu, V.M.S.; Cardello, M.; Friedman, A.M.; Fordham, E. W. (Rush-Presbyterian-St. Luke's Medical Center, Chicago). Cancer; 37: No. 3, 1432-1442(Mar 1976).

Extensively irradiated patients were studied from 0 to 73 months after irradiation by ^{52}Fe bone marrow scanning. Marrow regeneration was observed in most patients after intervals of 12 months or longer. The degree of recovery was not dose-related and the marrow ablative dose was not defined with doses of 4000-5000 rads. Degree of recovery depended more upon the antomic region and/or sequence of fields treated; the last field treated invariably showed poorer regeneration when recovery was uneven. Active erythropoiesis expanded into distal inactive erythropoietic sites from 3 to 12 months after irradiation and then decreased thereafter. Blood count cytopenias were almost always restricted to the first year after irradiation.

29903 DIAGNOSIS OF MECKEL DIVERTICULUM BY SODIUM PERTECHNETATE /sup 99m/Tc SCAN. Cooper, M. (Walter Reed Army Medical Center, Washington, DC). J. Am. Med. Assoc.; 235: No. 14, 1471-1472(5 Apr 1976).

Meckel diverticulum was diagnosed preoperatively as the cause of recurrent rectal bleeding in a 2-year-old child by means of a sodium pertechnetate Tc 99m scan. Although false-negative scans have been reported to occur in approximately 50 percent of all cases of Meckel diverticulum, the procedure should be considered in any case of unexplained, painless rectal bleeding, especially in pediatric patients.

29904 ACCURACY OF $^{111}InCl_3$ AS A BONE MARROW SCANNING AGENT. Gilbert, E. H.; Earle, J. D.; Goris, M. L.; Kaplan, H. S.; Kriss, J. P. (Stanford Medical Center, CA). Radiology; 119: No. 1, 167-168(Apr 1976).

From 62nd scientific assembly and annual meeting; Chicago, IL, USA (14 Nov 1975).

The number of normal cellular elements present in bone marrow biopsies was compared to the extent of uptake at corresponding sites on $^{111}InCl_3$ bone marrow scans in 87 patients with malignant lymphoma. Of the biopsies free of tumor, 49/54 interpreted as normocellular and 16/17 hypocellular or aplastic confirmed the scan interpretation. Of the biopsies demonstrating tumor, 10/11 of those interpreted as normocellular and 14/15 hypocellular or aplastic confirmed the scan interpretation. The $^{111}InCl_3$ bone marrow scan is accurate in depicting the presence or absence of normal marrow elements, but is of value in detecting tumor only when the normal elements are extensively replaced. (auth)

29905 MARKED ENLARGEMENT OF THE LEFT LOBE OF THE LIVER CAUSING A FALSE-POSITIVE SPLEEN IMAGE. Chaudhuri, T. K.; Bobbitt, J. V. (Eastern Virginia Medical School, Hampton). Radiology; 119: No. 1, 169-170(Apr 1976).

From 62nd scientific assembly and annual meeting; Chicago, IL, USA (14 Nov 1975).

In 10 patients with a markedly enlarged left lobe of the liver, the posterior (prone) views (/sup 99m/Tc-sulfur colloid) revealed a false-positive splenic defect. In 1 case the defect was also apparent in the anterior view. In all but 1 case this pseudodefect was not present in the posterior image obtained standing up. Use of a spleen-specific or liver-specific radionuclide agent was necessary in that case. The authors caution against diagnosis from an apparently abnormal posterior image unless proved by other measures. (auth)

29906 BRAIN SCANNING IN INFLAMMATORY DISEASES (MENINGOENCEPHALITIS, CEREBRAL ABSCESS, SUBDURAL EMPYEMA). Deckart, H.; Grosch, G.; Winkelmann, H.; Scheibe, J. (Staedtische Klinik, Berlin). Radiobiol. Radiother.; 16: No. 6, 725-736(1975). (In German).

Whereas in 12 out of 13 cases of suppurative ME in our patient material a scintigraphic focal result was present, only 15 out of 33 patients with non-suppurative ME showed activity concentrations. Localized ME shows more frequently an accumulation than a diffuse one a topographic agreement of the EEG focal results with the scintigraphic ones not always being present. In longitudinal section examinations of an ME the development of an empyema or of an abscess can be observed scintigraphically: it is characterized by intense focally limited activity concentration. In increasing sealing-off a decrease in accumulation can be the result; often the capsular marking only is still demonstrable. Some examples in which the scintigraphic result only led to neurosurgical intervention verify the importance of scintigraphy for abscess recognition. In the process-like courses of an ME and of its complications one single instrumental diagnosis can only be referred to the momentary state of the picture of disease. Here scintigraphy offers itself to be used as often as one likes in the frame of longitudinal section examinations. A development of abscess is scarcely missed. Instrumental diagnosis (for example angiography) can then be limited to one single preoperative examination. (auth)

29907 INFLUENCE OF LABELLING CONDITIONS ON THE PROPERTIES OF ^{113m}In-LABELLED FERRIC HYDROXIDE PARTICLES. Kleinert, P.; Schumann, E.; Endert, G.; Klose, E. (Radiologische Klinik und Poliklinik, Erfurt, Ger.). Radiobiol. Radiother.; 16: No. 6, 737-744(1975). (In German).

In order to lay down a modified labelling instruction for ^{113m}In-labelled ferric hydroxide particles the influence of the individual labelling conditions on the radiopharmacon is studied. For this the influence of iron concentration, stirring time, temperature, pH value, dispersion conditions and protecting colloid on particle size, labelling result and in-vitro stability of dispersion is experimentally determined. Increasing iron concentration in the area of 5 to 80 μg Fe/ml leads to a consolidation of agglomerates and necessitates intensified methods of dispersion. For complete coagulation of the colloidal ferric hydroxide a fixed time of reaction is necessary which can be strongly shortened by stirring. A pH value of 6.6 to 7.0 is sufficient for obtaining a labelling result of 96 to 98%. Addition of a protecting colloid can be omitted. On the basis of experimental results the following modified labelling instruction is recommended: In a 5 ml single-way syringe 3.0 ml eluate, 0.25 ml ferric chloride solution (100 mg $FeCl_3 \cdot 6H_2O$ per 100 ml 0.1 N HCl) and 0.7 ml ammonium acetate buffer (1 ml glacial acetic acid, 200 ml bidistilled water, 0.25% solution of ammonia up to pH 10.0) are slowly rotated for 3 min and then intensely shaken for 20 to 30s. Pulmoscintigrams of 340 patients were successfully carried out according to this method. Pulmonary clearance for 40 to 50% of ferric hydroxide resulted in a biological half-life of 8 to 10 hours and for 20 to 30% in a biological half-life of 15 to 30 days. (auth)

29908 RADIOIMMUNOLOGICAL TRIIODOTHYRONINE DETERMINATION. Lobers, W. (Staedtische Klinik, Berlin). Radiobiol. Radiother.; 16: No. 6, 755-760(1975). (In German).

We tested the RIA-Mat-T_3 set of instruments of Byk-Mallinckrodt for the determination of the triiodothyronine concentration in blood serum in routine operation. By incubation at room temperature the test series could be terminated within one working day. It is a radioimmunoassay only requiring 20 ml of serum per testing run. The antiserum should bind 65 to 75% of the used radioactively labelled amount of antigen. The precision in the series was with a mean standard deviation of $\pm 16\%$ the reason for threefold determinations. Examinations for finding again the amounts of triiodothyronine added to the mixed serum yielded on the average 99% of the T_3 concentrations expected. Our sample of normal values determined with the clinical staff yielded a standard range of 0.60 to 1.40 μg T_3/l with a mean value of 1.00 μg/l and a mean standard deviation of ± 0.23 μg/l. Conditions of hyperthyroid function could be very well separated from the euthyroid area. (auth)

29909 EXPERIENCES WITH ^{113m}In-LABELLED ERYTHROCYTES FOR SPLENOSCINTIGRAPHY. Loebe, J.; Kaempfer, I.; Deckart, H.; Weiland, J.; Weiss, M. L.; Krug, C. (Karl-Marx Univ., Leipzig). Radiobiol. Radiother.; 16: No. 6, 761-766(1975). (In German).

It was found that there was a high-degree splitting of technetium in vivo and with that a representation of the stomach without a demonstrable reason. Therefore it is important to be able to apply a second procedure which makes possible to carry out splenoscintigraphy at the same day with the same patient. The preparation of ^{113m}In-labelled erythrocytes was made with the addition of small amounts of acetyle-acetone in phosphate buffer. On the average labelling results of 87% could be obtained. The indium-labelled erythrocytes possess a high in-vitro stability. In the clinical use a thermic alteration of the ^{113m}In-erythrocytes for splenoscintigraphy was shown to be probably not necessary. The examinations yielded in 25 out of 26 cases a demonstrable activity maximum above the spleen, in 8 cases the liver was also represented. For reinjection an NaCl-^{113m}In-spherocyte mixture with

an activity of 400 to 500 μCi was used. 30 Minutes after reinjection scintiscannings in several positions are possible. (auth)

29910 COMPLEX RADIOLOGICAL PAROTID DIAGNOSIS. Heider, U.; Steinwandt, G.; Schumann, E.; Klose, E. (Radiologische Klinik und Poliklinik, Erfurt, Ger.). Radiobiol. Radiother.; 16: No. 6, 787-794(1975). (In German).

The advantages of summarizing the different radiological methods of examination radioisotope sialography, static and sequence scintigraphy, x-ray sialography for the complex radiological parotid diagnosis are represented by persons with healthy parotid glands and by patients with parotid tumours. Weighing the statement value of the individual radiological methods of examination, their technique and special indication for different parotid diseases were especially important. (auth)

29911 BRAIN SCANNING DISPENSARY IN THE EARLY DETECTION OF RECURRENT TUMORS. Grosch, G.; Borchardt, U.; Deckart, H.; Winkelmann, H. (Staedtische Klinik, Berlin). Radiobiol. Radiother.; 16: No. 6, 795-802(1975). (In German).

Within complex diagnostical measures for the early detection of recurrences of brain tumours the value of the used method was checked on 102 patients with the danger of recurrences. Clinic, EEG and angiography were compared to scintigraphy classified according to tumour types and localization. 44 recurrence patients were detected 36 of them being primary recurrences, 7 secondary recurrences, one patient had a third recurrence. Histology of the recurrent tumours revealed 14 astrocytomas, 8 glioblastomas, 6 meningeomas, 4 oligodendrogliomas, 3 ependymomas, and 1 fibrosarcoma. 3 tumours were not histologically clarified. It could be found that the otherwise high statement power of EEG did not correlate in any case with the scintigraphic result. The reappearance of a fit disease after tumor operations rendered detection of recurrences in EEG difficult. The demonstration of space requirements in angiographically dumb areas could be made angiographically. These are recurrent tumours growing in the operation cavity and parietal and parieto-temporal, respectively, localizations. (auth)

29912 SATURATION ANALYSIS. (to Radiochemical Centre Ltd.). Netherlands Patent 7,416,131/A/. 11 Dec 1974. Priority Date 11 Dec 1973, United Kingdom of Great Britain and Northern Ireland (UK). 19p. (In Dutch).

A radioimmunoassay kit for the determination of folates and folic acid is presented. The chemical procedures for labelling folic acid compounds with Selenium-75 are described and analytical examples given. (NL)

29913 SATURATION ANALYSIS. (to Radiochemical Centre Ltd.). Netherlands Patent 7,416,132/A/. 11 Dec 1974. Priority Date 11 Dec 1973, United Kingdom of Great Britain and Northern Ireland (UK). 19p. (In Dutch).

The invention comprises a radioimmunoassay kit for steroid determination. Selenium-75 is used as labelling element. The chemical preparation methods for various selenium-labelled ketosteroids and their derivatives, such as hydrocortisone, testosteron, corticosteron, estriol, and other steroid hormones as well as cardiacal glycosides are described. Analytical examples are presented. (NL)

29914 USE OF CHOLYL-(1-^{14}C)GLYCINE FOR THE INVESTIGATION OF INTESTINAL DISFUNCTION. Rijken, J. (Rijksuniversiteit, Groningen, Netherlands). Ned. Tijdschr. Geneesk.; 119: No. 44, 1742(1 Nov 1975). (In Dutch).

From conference on the Dutch Society of Nuclear Medicine; Utrecht, Netherlands (21 Feb 1975).

29915 CARBON-11 AMINO ACIDS FOR PANCREAS SCINTIGRAPHY. Vaalburg, W.; van der Molen Beerling, H. D.; Reiffen, S.; Rijskamp, A.; Woldring, M. G.; Wijnberg, H. (Rijksuniversiteit, Groningen, Netherlands). Ned. Tijdschr. Geneesk.; 119: No. 44, 1742-1743(1 Nov 1975). (In Dutch).

From conference of the Dutch Society of Nuclear Medicine; Utrecht, Netherlands (21 Feb 1975).

29916 EXPERIENCES WITH ANALYTICAL KITS FOR THE DETERMINATION OF ^{125}I-LABELLED DIGOXIN. van Woudenberg, F.; Camps, J.; Hooyer, L. Ned. Tijdschr. Geneesk.; 119: No. 44, 1743(1 Nov 1975). (In Dutch).

From conference of the Dutch Society of Nuclear Medicine; Utrecht, Netherlands (21 Feb 1975).

29917 THREE-COMPARTMENT MODEL OF HIPPURAN DISTRIBUTION. van Stekelenburg, L. H. M. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands); Kooman, A.; Terholen, J. F. W. Ned. Tijdschr. Geneesk.; 119: No. 44, 1743(1 Nov 1975). (In Dutch).

From conference of the Dutch Society of Nuclear Medicine; Utrecht, Netherlands (21 Feb 1975).

29918 BONE MARROW SCINTIGRAPHY WITH IRON-52. Samson, G.; van der Schoot, J. B. (Univ., Amsterdam). Ned Tijdschr. Geneesk.; 119: No. 44, 1744(1 Nov 1975). (In Dutch).

From conference of the Dutch Society of Nuclear Medicine; Utrecht, Netherlands (21 Feb 1975).

29919 UNUSUAL PHOTOPEAK IN A SODIUM IODIDE SCINTILLATION DETECTOR. van Damme, K. J. (Instituut voor Radiopathologie en Stralenbescherming, Leiden). Ned. Tijdschr. Geneesk.; 119: No. 44, 1744(1 Nov 1975). (In Dutch).

From conference of the Dutch Society of Nuclear Medicine; Utrecht, Netherlands (21 Feb 1975).

29920 SCANNING ELECTRON MICROSCOPIC STUDY ON EPIPHYSEAL GROWTH CARTILAGE IN NORMAL AND EXPERIMENTAL RICKETS, AND ELEMENTAL ANALYSIS WITH ENERGY SCATTERING TYPE OF X RAY SPECTROMETER. Takada, S.; Yamamoto, Y. (Tottori Univ., Yonago (Japan). School of Medicine). Kotsu Taisha; 8: No. 1, 79-87(Oct 1974). (In Japanese).

Scanning electron microscope was equipped with energy scattering type of x-ray spectrometer (EDX), and the secondary figures of the epiphyseal growth cartilage were observed. In addition, poly-elements were simultaneously analyzed by setting analysis spots in the random points. As a result, it was found that Ca, P and S elements increased and decreased in each zone, and new information on the calcification mechanism in the cartilage matrix was obtained. Epiphyseal growth cartilages in the proximal end of tibia in normal young dogs and dogs with experimental rickets were used as experimental materials. Elemental analysis was done by spot analysis method and characteristic x-ray of each element was detected by irradiating electron rays with sample electric current 3×10^{-11} A of 20 KV of acceleration voltage for 150 seconds. (1) Cartilage cells were degenerated and swollen in the upper part of frothy layers. S was decreased, while Ca and P reached the maximum. Amorphous and noncrystalline calcium phosphate was suspected. (2) Apatite crystalline mass was observed in calcified layers of normal growth cartilage. This apatite contained Ca and P, but no S. (3) The results obtained by the elemental analysis in growth cartilage of rickets were the same as those in normal cartilage. Apatite crystalline mass was not observed in cases of rickets. Ca and P were increased to the peak. Therefore, in rachitic epiphysial cartilage, the disturbance of the transformation of amorphous calcium phosphate to crystalline apatite was suspected. (INIS)

29921 THE METABOLIC FATE OF ^{57}Co-METHYLCOBALAMIN IN THE RAT WITH A CRUSHED SCIATIC NERVE. Especially on the Uptake by the Nerve Tissue and By Muscles Innervated By Sciatic Nerves. Kinoshita, K.; Yanagi, K.; Fujita, T.; Yamatsu, K. (Eisai Co. Ltd., Tokyo (Japan). Research Lab.). Chem. Pharm. Bull. (Tokyo); 22: No. 10, 2252-2257(Oct 1974).

The metabolic fate of ^{57}Co-labeled methylcobalamin (^{57}Co-CH_3-B_{12}) at various doses (5, 50 and 500 μg/kg/day) after consecutive, intraperitoneal administration within 7 days to rats, of which the right sciatic nerve was degenerated by crushing, was studied. The uptake of radioactivity by sciatic nerve in both sides was increased with time and doses but the radioactivities in sciatic nerve and muscles innervated by this nerve such as musculus gastrocnemius were significantly higher in crushed side than in intact one at all doses investigated. The distribution of radioactivity in tissues other than nerve and muscles was also increased with time and doses. The highest uptake was observed in kidney, followed by adrenal gland, pancreas and liver and the lowest in brain and testis. The urinary excretion of radioactivity in each dosage within 24 hr after every administration of ^{57}Co-CH_3-B_{12} was found to be nearly constant at each dose during 7 days, namely, about 25, 70 and 75%/day at 5, 50 and 500 μg/kg/day, respectively. (auth)

29922 IRON ABSORPTION STUDIES USING ISOTOPICALLY LABELLED VEGETABLES. Ortaliza, I. C.; Salamat, L. A.; Trinidad, T. P.; Jacob, F. O. (National Inst. of Science and Technology, Manila (Philippines). Food and Nutrition Research Center); de la Cruz, B. (Philippine Atomic Energy Commission, Manila). Proc. Radioisot. Soc. Philipp.; 25-33(1974).

Iron absorption from some local vegetables tagged biosynthetically with Fe-59 was evaluated using normal rats. The technique used for tagging the vegetables is described. Mean iron absorption ranging from 4.5 to 9.1 was found with lettuce, kamote tops, petsay, mustase, kintsay and kangkong. When absorption values were computed in relation to the absorption of an iron salt, no statistical differences were found among the vegetables studied.

29923 SELECTION OF THE OPTIMUM PHOTON ENERGY FOR RADIONUCLIDES WITH COMPLEX SPECTRA USED WITH THE GAMMA CAMERA. Van Zyl, W. H.; Loetter, M. G.; Van Aswegen, A.; Minnaar, P. C. (University of the Orange Free State, Bloemfontein (South Africa). Dept. of Biophysics); Itur-

ralde, M.; Doman, M. V. (University of the Orange Free State, Bloemfontein (South Africa). Dept. of Radiotherapy). S. Afr. J. Sci.; 71: No. 5, 145-150(May 1975).

Radionuclides which emit photons with more than one energy are being increasingly used in scintigraphy. It is therefore important to evaluate the performance of scintigraphic systems for each photo-peak energy to ensure maximum performance. An investigation into the use of radioisotopes ^{75}Se, ^{169}Yb, ^{67}Ga and ^{111}In was made. A Nuclear Chicago Pho Gamma III gamma camera with a data-store and playback unit were used for this study. Since the radionuclides under investigation are mainly used for large-organ or whole-body imaging, a medium energy diverging collimator was used. A pulse height window of 20 was selected for all investigations. The line spread function and the isotopic energy spectra were investigated using a 144 channel pulse height analyzer.

29924 HIGH RESOLUTION RADIOAUTOGRAPHY AND DYNAMICS OF MEMBRANES. Droz, B.; Pisam, M.; Di Giamberardino, L.; Boyenval, J.; Hassig, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. de Biologie); Koenig, H. L. (Paris-6 Univ., 75 (France)). Bull. Inf. Sci. Tech. (Paris); No. 207, 7-17(Oct 1975). (In French).

Electron microscope radioautography enables the sites of synthesis and the intracellular transport of membrane components in various types of cells, e.g., retinal cones and rods, epithelial cells of the amphibian urinary bladder and neutrons, to be specified. (FR)

29925 ACTIVATION ANALYSIS. Maziere, B. pp 173-198 of Treatise of Nuclear Medicine. Vol. 1. Theoretical Basis. Meyniel, G.; Berger, J. A.; Chanteur, J.; Cohen, Y.; Di Paola, R.; Ducassou, D.; Gaillard, G.; Isabelle, D.; Lahneche, B.; Martin, J. Paris, France; Flammarion Medecine Sciences (1975). (In French).

The principle of activation analysis is reported and analyses by neutron, γ photon and charged particle activation are dealt with in turn. The biomedical value of activation analysis is shown, especially with regard to trace element analysis in vitro and analysis of the main components of the organism in vivo. (FR)

29926 SPECIFIC RADIOANALYSIS OF BIOLOGICAL MATERIALS. Rosselin, G. pp 199-230 of Treatise of Nuclear Medicine. Vol. 1. Theoretical Basis. Meyniel, G.; Berger, J. A.; Chanteur, J.; Cohen, Y.; Di Paola, R.; Ducassou, D.; Gaillard, G.; Isabelle, D.; Lahneche, B.; Martin, J. Paris, France; Flammarion Medecine Sciences (1975). (In French).

Theoretical and practical aspects of the specific radioanalysis of biological media are shown by successive discussions on reference substances; radioactive tracers; specific proteins; separation of the free and the bound product; preparation of samples for analysis; equilibrium and kinetics of reactions; specificity of reactions; application to functional explorations in man. A practical example of radioanalysis is given: insulin determination by radioimmunological method. (FR)

29927 RADIOPHARMACOLOGY. Cohen, Y.; Hegesippe, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. des Radioelements); Berger, J. A.; Gaillard, G. pp 231-244 of Treatise of Nuclear Medicine. Vol. 1. Theoretical Basis. Meyniel, G.; Berger, J. A.; Chanteur, J.; Cohen, Y.; Di Paola, R.; Ducassou, D.; Gaillard, G.; Isabelle, D.; Lahneche, B.; Martin, J. Paris, France; Flammarion Medecine Sciences (1975). (In French)

Radiopharmacology covers both the standard drug, once it is labelled by a radionuclide, and the radiopharmaceutical preparation, i.e., the radioelement or labelled molecule put into a form immediately administrable to man for treatment or diagnosis. The following subjects are examined in turn: radiopharmacological methods in vivo and in vitro; the pharmacology of radiopharmaceutical substances (pharmacokinetics, pharmacodynamics, radiobiology); the distribution of labelled drugs in the organism. The contribution of radionuclides and labelled molecules in the explanation of correlations between the metabolism and the drug action is shown. (FR)

29928 ORGANISATION OF NUCLEAR MEDICINE SERVICES. Health Physics. Technical and Administrative Arrangement. Chanteur, J.; Pellerin, P. pp 245-264 of Treatise of Nuclear Medicine. Vol. 1. Theoretical Basis. Meyniel, G.; Berger, J. A.; Chanteur, J.; Cohen, Y.; Di Paola, R.; Ducassou, D.; Gaillard, G.; Isabelle, D.; Lahneche, B.; Martin, J. Paris, France; Flammarion Medecine Sciences (1975). (In French).

Apart from safety and quality requirements the organisation of nuclear medicine services, or more generally of installations where non-sealed radioactive sources are used, is governed by profitability and efficiency criteria. In view of the high price of products and apparatus the equipment must be based on a rationalization of options guiding the organization arrangements as a whole. The following items are dealt with in succession: various categories of installations; general planning of equipment; equipment regulations based on a major requirement, the confinement of contamination sources; working rules examined with respect to the systematics adopted by the International Health Physics Commission and referred in turn to the protection of the patient and that of the surroundings practical observations concerning administrative and technical questions. (FR)

29929 STUDIES OF IN VIVO RADIO-ACTIVE INDIUM-BINDING PROTEINS. Dassin, E.; Boulard, M.; Rain, J. D.; Najean, Y. (Hopital Saint-Louis, 75- Paris (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 281: No. 12, 859-862(22 Sep 1975). (In French)

After in vivo infusion, radio-active indium is fixed by liver and bone marrow, but more slowly and less completely than iron. It does not incorporate to haem. It is found as labelled ferritin in the liver, after the fifth day. In the bone marrow, indium is almost exclusively found as labelled transferrin; several arguments suggest the intra-cellular site of the labelled protein. Using indium may enable a better knowledge of the intermediary iron pools. (FR)

29930 RADIOISOTOPIC LYMPHOGRAPHY BY THE INDIRECT ROUTE OF THE ABDOMINO-PELVIC LYMPHATIC CHAINS. Value of Antimony Sulfocolloid Labelled with Technetium 99m. Arnaud, D.; Ducassou, D.; Vilayleck, S. (Hopital Pellegrin, 33- Bordeaux (France)); Dilhuydy, J. M. (Hopital Saint-Andre, 33- Bordeaux (France)). Ann. Radiol.; 18: No. 5, 509-512(1975). (In French)

In comparison with the colloids used until now, the antimony sulfocolloid labelled with ^{99m}Tc used in carrying out radioisotopic lymphography of the abdomino-pelvic chains is closer to the tissue proteins because of its polyvinyl-pyrolidone envelope. After describing the images obtained in subjects without any ganglion lesions, the different abnormal images observed in 28 pathological cases are described. Although there is not always a close relationship between these abnormal images and metastatic invasion of the ganglion chain, this examination, which is innocuous and simple to carry out, seems to be of particular value in the search for metastatic extension of a known primary cancer, and in the surveillance of therapy, as well as in the determination of the irradiation field of an invaded ganglion zone. (FR)

29931 ^{169}YTTERBIUM CITRATE: INTEREST IN CANCEROLOGY. Chatal, J. F.; Le Mevel, B. P.; Guihard, R.; Guihard, D. (Centre Regional de Lutte Contre le Cancer Rene-Gauducheau, 44- Nantes (France)); Moigneteau, C. (Centre Hospitalier Universitaire, 44- Nantes (France)). J. Radiol., Electrol., Med. Nucl.; 56: No. 5, 401-409(May 1975). (In French)

Several radio-nuclides are used in cancerology for their tumoral tropism and, in fact, gallium-67 citrate and ^{57}Co bleomycin almost exclusively. But, these nuclides have some disadvantages, so the interest to ytterbium-169 citrate was evaluated; this radiolanthanide has already been studied in animals for its affinity for tumoral and normal tissues. The preliminary study has been made on 44 patients bearing different neoplastic diseases. In 8 cases, the percent radioactivity excreted by urines and stools in 5 days following injection was measured. Scintigraphy of most of the patients has been made at 48 hours, but for several cases of non malignant or malignant pulmonary diseases, a kinetic study allowed to follow the evolution of the intensity the pathological fixation. The results show: a weak urinary and fecal excretion; a good scintigraphic contrast from 48 hours; an important radioactive fixation in bone metastasis of various origins, in primary and secondary brain and liver tumors; an important radioactive fixation in lungs cancers and inflammatory diseases. The preliminary kinetic study seems to be a good means of differential diagnosis. At the cost of a non negligible irradiation dose of bone, the tumoral fixation can be considered as good and the kinetic studies will perhaps improve the specificity of the diagnosis. (FR)

29932 MEASUREMENT OF FLOW IN THE CORDIS-HAKIM TYPE VENTRICULAR SHUNT VALVE, USED IN THE SURVEILLANCE OF HYDROCEPHALIC PATIENTS WITH SHUNTS. An Experimental Study. Orgogozo, J. M. (Centre Jean-Abadie, 33- Bordeaux (France)); Castel, J. P.; Cohadon, F. (Hopital Pellegrin, 33- Bordeaux (France)); Ducassou, D. (Hopital du Haut-Leveque, 33- Pessac (France)). J. Radiol., Electrol., Med. Nucl.; 56: No. 6, 513-516(Jun 1975). (In French)

Using isotopes, Benabib et al. were able, in 1970, to evaluate the function of a ventricular shunt system by measuring the flow passing through it. The experimental study carried out confirmed the applicability of the method described by Benabib et al. to

the Cordis-Hakim valve after substitution of the ^{131}I used by $^{99m}TcO_4$. Measurement of flow is valid only if true flow lies between 0.085ml/mn and 1.7ml/mn. Although with flow rates of less than 0.07ml/mn the values obtained are overestimated, the distinction between no flow and slight flow remains definite. (FR)

29933 ERROR INTRODUCED IN THE RADIOCARDIOGRAPHIC MEASUREMENT OF RIGHT VOLUME BY THE NON-LINEARITY OF THE DETECTOR IN HIGH COUNT RATES. Morin, P. P.; Morin, J. F.; Caroff, J.; Savina, A.; Lahellec, M.; Thomas, J. (Centre Hospitalier Regional Augustin-Morvan, 29N-Brest (France)). J. Radiol., Electrol., Med. Nucl.; 56: No. 6, 517-522 (Jun 1975). (In French)

The short life tracers permit the use of high activities and so allow to follow with a good statistic accuracy fast phenomena such as the different phases of cardiac revolution. However, this advantage may be quickly limited by the dead-time of the detection unit used. It results from this, in high activities, a non-linear response which introduces non negligible errors which have been calculated and experimentally verified in the measurement of right ventricular volumes. (FR)

29934 RADIOIMMUNOASSAY OF PARATHYROID HORMONE (PTH) IN HYPERPARATHYROIDISM (H.P.T.) (38 CASES). Merceron, R. E.; Raymond, J. P.; Courreges, J. P.; Klotz, H. P. (Hopital Beaujon, 92-Clichy (France)); Paillard, F. (Hopital Tenon, 75-Paris (France)). Ann. Endocrinol. (Paris); 36: No. 4, 217-218(Jul 1975). (In French)

The P.T.H. radioimmunoassay was done in 38 cases of suspected H.P.T. In confirmed primary H.P.T., the dosage was in positive correlation in 75% of cases; the classic metabolic exploration was in good correlation in 81% of cases. The specificity of the dosage is good but the defect of correlation comes from the antiserum utilized which recognizes the NH2-terminal region of human P.T.H. (FR)

29935 DIAGNOSTIC VALUE OF RADIOACTIVE FIBRINOGEN AND RHEOGRAPHY IN PHLEBITIS. Serradimigni, A.; Bory, M.; Djiane, P.; Sacerdote, P.; Mathieu, P.; Leonetti, J.; Egre, A. (Centre Hospitalier Universitaire de la Timone, 13-Marseille (France)). Nouv. Presse Med.; 4: No. 31, 2253-2256(27 Sep 1975). (In French)

In 212 patients the diagnostic value of radioactive fibrinogen and rheography in deep venous thrombosis in the leg was studied by comparing the results from these two methods with phlebography. Radioactive fibrinogen seems the better means of diagnosis in early distal phlebitis. However, the method is expensive, the radioactive substance can only be manipulated in certain specialized centers, and is useless in the presence of hematoma. Rheography is less expensive, more easily manipulated, yet less sensitive as only proximal phlebitis can be detected especially when completely occlusive. In addition, active patient cooperation is necessary. The time needed to realize the two methods is a major obstacle; however, they can be fruitful if integrated into a specialized department for the diagnosis and treatment of thrombo-embolic disease. (FR)

29936 RADIOIMMUNOASSAY OF CALCITONIN (T.C.T.) IN TUMORAL THYROID PATHOLOGY (84 CASES). Merceron, R. E.; Delorme, M. L.; Raymond, J. P.; Courreges, J. P.; Vallee, G.; Klotz, H. P. (Hopital Beaujon, 92-Clichy (France)). Ann. Endocrinol. (Paris); 36: No. 4, 219-220(Jul 1975). (In French)

The dosage of calcitonin was done in 13 thyroid carcinoma and 71 benign thyroid tumors. In one case, the preoperative diagnosis of medullary thyroid carcinoma (M.T.C.) was allowed; in another case of M.T.C. the repeated dosage allows the evolution survey and the exploration of the family; in a third case, the dosage allows to doubt the diagnosis of M.T.C. in post-mortem. In 71 cases of benign thyroid tumors, the calcitonin immunoassay is in the normal range. The interest and limits of the preoperative dosage was drawn from this experience. (FR)

29937 SINUSOIDAL SHUNT FRACTION BY RADIOEXTRACTION RATIO. Bradley, E. L. III; Quinton, D. L.; Martin, L. G.; Kourias, E.; Larose, J. (Emory Univ., Atlanta). Surgery; 76: No. 6, 918-924(Dec 1974).

From 28th annual meeting of the Society for Vascular Surgery; Chicago, Illinois (USA) (20 Jun 1974).

A new technique for the measurement of hepatic sinusoidal perfusion and shunt fraction based upon the degree of extraction of particulate material by the hepatic reticuloendothelial system (RES) is presented. Repeated control determinations were highly reproducible (p greater than 0.40). Using each animal as its own control, significant increases (p less than 0.001) in nonsinusoidal perfusion were noted after either side-to-side or end-to-side portacaval shunting. While further development is necessary, the principles underlying this study appear promising. (auth)

29938 RADIOIMMUNOASSAY TO DETERMINE THE SUBTYPES D AND Y OF THE HEPATITIS-B SURFACE ANTIGEN. Thamer, G.; Kommerell, B. (Heidelberg Univ. Hospital). J. Lab. Clin. Med.; 87: No. 4, 734-738(Apr 1976).

A radioimmunologic test system for determining the subtypes D and Y of the hepatitis-B surface antigen (HB/sub s/-Ag, Australia antigen, HAA) is described. This technique uses the immunoadsorption principle. The antigen to be subtyped is incubated with an antiserum which contains ^{125}I-labeled antibodies to the antigenic determinants a, d, and y. The specificity of the antibody which is not consumed in forming the antigen-antibody complex is determined by absorption on agarose to which HB/sub s/-Ag of subtypes D and Y is coupled. This specificity permits conclusions as to the subtype of the hepatitis-B surface antigen which is being investigated. (auth)

29939 EDGE DETECTION ALGORITHMS IN NUCLEAR MEDICINE. Cahill, P. T.; Ornstein, E.; Ho, S. L. (Polytechnic Inst. of New York, Brooklyn). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 555-559(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Camera scans of phantoms and kidneys are computer processed to extract boundaries between areas of different densities. Several methods of edge detection are critically evaluated for their ability to determine boundaries in the presence of stochastic noise. A second order polynomial fit, utilizing the nearest neighbor method was found to be the most efficient method yielding the most consistent results for varying signal to noise ratios.

29940 REGIONAL IMAGING WITH ^{14}O. Russ, G. A.; Bigler, R. E.; Dahl, J. R.; Kostick, J.; McDonald, J. M.; Tilbury, R. S.; Laughlin, J. S. (Memorial Sloan-Kettering Cancer Center, New York). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 573-576(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The metabolic significance of the distribution of labeled oxygen was studied in the dog by inhalation of gas mixtures labeled with oxygen-14 ($T/sub\ 1/2$ equals 71 seconds) maintained at a constant level of activity. Under steady-state conditions, whole body images were developed by detection of the positron annihilation emissions with a dual head rectilinear scanner in the coincidence mode.

29941 MYOCARDIAL POSITRON SCINTIGRAPHY WITH SHORT-LIVED ^{82}Rb. Hoop, B. (Massachusetts General Hospital, Boston); Beh, R. A.; Beller, G. A. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 584-589(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Positron-emitting 78-sec ^{82}Rb obtained from a ^{82}Sr (25 day) nuclide generator is used with a multicrystal positron camera for serial non-invasive myocardial scanning. Progress in application of this generator for myocardial scintigraphy from December 1974 to September 1975 is reported. Physical characteristics of the generator and scanning system were examined with the aid of phantom models. Myocardial scanning was carried out in an open chest canine myocardial infarct preparation and in normal human subjects. It is concluded that positron scintigraphy with ^{82}Rb permits rapid non-invasive assessment of regional myocardial perfusion at intervals of several minutes.

29942 THROMBUS DETECTION USING ^{125}I-FIBRINOGEN AND A CdTe PROBE. Garcia, D. A. (Veterans Administration Hospital, West Roxbury, MA); Frisbie, J. H.; Tow, D. E.; Sasahara, A. A.; Entine, G. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 594-598(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A compact CdTe detector system was developed for use in a clinical screening test for venous thrombosis of the legs. Patients given intravenously administered autologous ^{125}I-fibrinogen were probed externally at selected points on the thighs and calves for abnormal accumulations of radioactivity. Measurements made with the CdTe probe were compared to those obtained with a standard portable NaI detector system. The CdTe probe was the equal of the NaI detector in diagnostic capability. The compact design of the semiconductor system considerably eased the probing procedure, especially in bedridden patients with limited mobility of the extremities.

29943 MEASUREMENT OF ABSOLUTE LUNG DENSITY BY COMPTON-SCATTER DENSITOMETRY. Kaufman, L. (Univ. of California, San Francisco); Gamsu, G.; Savoca, C.; Swann, S.; Murphey, L.; Hruska, B.; Palmer, D.; Ullman, J. IEEE Trans. Nucl. Sci.; NS-23: No. 1, 599-605(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The non-invasive determination of absolute lung density would be of great importance if it could be used in the evaluation of

patients with pulmonary edema. To obtain this measurement, we have developed a portable densitometer using CdTe room-temperature detectors, compact collimators made of tantalum tubes and a ^{153}Gd source. System response in the density range of 0.1 to 1 g/cm^3 is linear. Variations in the absorption paths of up to 8 cm of lucite do not produce significant changes on measured density values.

29944 RADIOIMMUNOASSAY FOR DETECTION OF ANTIGEN AND ANTIBODIES TO NEWCASTLE DISEASE VIRUS. Spira, G.; Silvian, I.; Zakay-Rones, Z. (Hebrew Univ., Jerusalem). J. Immunol.; 116: No. 4, 1089-1092(Apr 1976).

When Newcastle disease virus (NDV) is treated with NP-40 and ether a membrane fraction of 150,000 m.w. is obtained. This fraction which is composed of two polypeptides with m.w. of 56,000 and 76,000 was used in a radioimmunoassay (RIA). The assay was developed for both antigen and antibody and was found to be reproducible, specific, and highly sensitive. Titers of 1 : 51,200 were determined by RIA as compared to 1 : 4 by agar gel diffusion and 1 : 200 by hemaglutination inhibition (HI). As little as 5 ng of viral protein were detected by RIA inhibition technique. Labeled antigen could be stored in the presence of serum, KCl and Triton X-100 at -20^{0}C for as long as 6 weeks and retained similar reactivity as fresh reagent.

29945 GONADOTROPIN-RELEASING HORMONE RADIOIMMUNOASSAY AND ITS MEASUREMENT IN NORMAL HUMAN PLASMA, SECONDARY AMENORRHEA, AND POSTMENOPAUSAL SYNDROME. Rosenblum, N. G.; Schlaff, S. (Jefferson Medical Coll., Philadelphia). Am. J. Obstet. Gynecol.; 124: No. 4, 340-347(15 Feb 1976).

A sensitive and specific double antibody radioimmunoassay for gonadotropin-releasing hormone (GnRH) has been developed for measurement in ethanol extracts of human plasma. Iodinated hormone was prepared with the use of the chloramine-T method, and antibodies were developed in rabbits over a six-month period with a GnRH synthetic copolymer immunogen. A Scatchard plot revealed at least three species of antibody. The assay can measure conservatively at the 5 pg. per milliliter level and shows no cross-reactivity with other available hypothalamic and pituitary hormones. The releasing hormone was quantitatively recovered from human plasma with immunologic identity to native hormone. Unextracted plasma could not be used because of nonspecific displacement. The measurement of GnRH in individuals receiving 100 mu g of intravenous bolus infusions of the synthetic decapeptide show extremely elevated values with two half-lives: one of two to four minutes and another of 35 to 40 minutes. In our experiments, we have found measurable GnRH in patients with secondary amenorrhea and at the midcycle in normal women. In the normal cycling woman during the follicular and luteal phases, GnRH was undetectable. In postmenopausal women with extreme hypoestrogenism and markedly elevated luteinizing hormone values, GnRH was also undetectable. No bursts of GnRH could be detected in normal men when sampled every ten minutes over a two-hour period and every two hours throughout the day. (auth)

29946 ^{111}In-BLEOMYCIN BREAST AND AXILLA IMAGING. Silverstein, M. J.; Verma, R. C.; Greenfield, L.; Morton, D. L. (Univ. of California, Los Angeles). Cancer; 37: No. 1, 36-42 (Jan 1976).

From 28th annual meeting of the James Ewing Society; New Orleans, LA, USA (25 Mar 1975).

^{111}Indium-Bleomycin (^{111}In-Blm), a new radiopharmaceutical, was administered intravenously to 37 patients with benign and malignant breast lesions. Early and delayed images of both the breasts and axillae were made, and results were correlated with physical examination, histopathology of the excised lesion, mammography, and thermography. In 18 patients with malignant disease, clinical examination of the breast and axilla correlated with histopathology in 78 and 54 percent of the cases, respectively. Images of the breast were accurate (true positives) in 83 percent of the cases. Images of the axilla were accurate in 62 percent of the cases. Mammography was correct and suggested malignancy in 88 percent, and thermography in 73 percent of the cases. In 19 patients with benign breast lesions, clinical examination of the breast and axilla correlated with histopathology in 68 and 95 percent of the cases, respectively. Scans of the breast and axilla were correct (true negative) 79 and 95 percent of the time, respectively. Mammography was correct, and suggested benignancy, in 53 percent and thermography in 25 percent of the cases. Imaging of the breasts using ^{111}In-Blm appears to be as accurate as physical examination and mammography for palpable benign and malignant breast tumors. (auth)

29947 GALLIUM-67 CITRATE SCANNING IN HODGKIN'S DISEASE AND NON-HODGKIN'S LYMPHOMA. Horn, N. L.; Ray, G. R.; Kriss, J. P. (Stanford Univ., CA). Cancer; 37: No. 1, 250-257(Jan 1976).

Gallium-67 citrate scintigraphy was performed in 33 patients with Hodgkin's disease and 25 patients with non-Hodgkin's lymphoma. Three hundred twenty-eight sites of potential involvement were investigated. Confirmation of involvement was made by physical examination, roentgenographic evaluation and histopathologic examination of tissue obtained at diagnostic laparotomy. The results of scintigraphy correlated with all other clinicopathologic data in only 35 percent of patients, the true-positive rate being significantly higher above the diaphragm (61 percent) than below (40 percent). The overall true-positive and true-negative rates were 53 and 90 percent, respectively. Gallium-67-citrate scintigraphy may be useful as an adjunct to established clinical staging procedures in untreated patients and in the detection of recurrent disease in treated patients. Our data indicate it is not sufficiently reliable to replace established methods presently used for clinical staging. (auth)

29948 SINGLE PALPABLE THYROID NODULE. Evaluation by /sup 99m/Tc-Pertechnetate Imaging. Alderson, P. O.; Sumner, H. W.; Siegel, B. A. (Washington Univ., St. Louis). Cancer; 37: No. 1, 258-265(Jan 1976).

The role of /sup 99m/Tc-pertechnetate thyroid imaging in the preoperative assessment of patients with single palpable thyroid nodules was evaluated. The frequency of cancer in hypofunctional nodules was similar to that found in previous studies with ^{131}I. The /sup 99m/Tc-pertechnetate image allowed a reliable separation of pathologically uninodular thyroids from those that were multinodular, and demonstrated multiple thyroid lesions that had not been detected by physical examination in over one-third of the cases. The frequency of cancer in thyroids containing a solitary or dominant hypofunctional nodule was higher (17 percent) than that in thyroids with a multinodular scan appearance (less than 5 percent). (auth)

29949 MICROTITER SOLID-PHASE RADIOIMMUNOASSAY FOR HEPATITIS A ANTIGEN AND ANTIBODY. Purcell, R. H.; Wong, D. C.; Moritsugu, Y.; Dienstag, J. L.; Routenberg, J. A.; Boggs, J. D. (National Inst. of Allergy and Infectious Diseases, San Diego, CA). J. Immunol.; 116: No. 2, 349-356(Feb 1976).

A microtiter solid phase radioimmunoassay for hepatitis A antigen (HA Ag) and antibody (anti-HA) was developed. The test was more sensitive than immune adherence hemagglutination for detecting HA Ag and almost as sensitive for detecting anti-HA. The specificity and sensitivity of reagents were examined and optimum conditions for the test were determined. Radioimmunoassay, immune adherence hemagglutination, and immune electron microscopy were compared for detecting anti-HA. A serologic response to HA Ag was detected in paired sera from patients with type A hepatitis but not from patients with type B or non-A, non-B hepatitis by all three techniques. (auth)

29950 FLUX OF ZINC THROUGH A MACROPLANKTONIC CRUSTACEAN. Small, L. F.; Fowler, S. W.; Keckes, S. (International Atomic Energy Agency, Monaco). Radioact. Sea; No. 34, 437-452(1973).

A simple, linear model has been employed for an heuristic examination of the flux of zinc through the euphausiid Meganyctiphanes norvegica in the Mediterranean Sea. The model is generated from the basic equation $k_e = \mu_e + \lambda_e$, where k_e is the rate of ingestion of particulate zinc by the euphausiid, μ_e is retention of the element in newly elaborated body tissue, and λ_e is the rate of elimination of the element. For a first approximation, the k_e term is assumed to apply only to ingestion of particulate zinc, though the model can also be made to incorporate direct uptake of zinc from solution. The k_e term breaks down into $k_e = (Q_{ip})$, where Q_i = zinc concentration in ingested food and ρ_i = ingestion rate. The μ_e term is equivalent to $(Q_g \rho_g)$, where Q_g = zinc concentration in new tissue added in growth, and ρ_g = growth-rate. The λ_e term, which really sets the flux of zinc through M. norvegica, can be fractionated as $\lambda_e = (Q_f \rho_f) + (Q_m \rho_m) + (Q_c \rho_c) + (Q_x \rho_x) + \rho_e$, where Q_f, Q_m, Q_c, and Q_x are zinc concentrations in faeces, moults, dead carcases, and non-viable eggs, respectively, and ρ_f, ρ_m, ρ_c, and ρ_x are the respective rates of product. The ρ_e term accounts for excretion of dissolved metabolic productions. The Zn concentration in the food of M. norvegica was calculated to be approximately 400-450 μg Zn/g dry weight to satisfy the elimination and growth terms. Measured Zn concentration in "natural" foods of the euphausiid averaged 570 μg Zn/g dry, an estimate reasonably close to the calculated concentration. The Zn budget in M. norvegica is thus adequately described, and indicates that faecal pellet deposition ($Q_f \rho_f$) is the most significant term (representing over 90% of the Zn flux). Applicability of the above approach, and the most sensitive parameters, are discussed relative to other elements and other organisms.

MATERIALS

29951 (STI/PUB-396(Vol. 1)) SURFACE SCIENCE. Volume I. Proceedings of a Symposium Held in Trieste, Italy, 16 January–10 April 1974. (International Atomic Energy Agency, Vienna (Austria)). 1975. 504p. (CONF-740139-P1). IAEA $31.00.

From international meeting on surface science; Trieste, Italy (16 Jan 1974).

Twelve papers are included on structure and properties of surfaces: surface thermodynamics, ideal structures, surface waves, LEED, nucleation and crystal growth, Brillouin–Wigner theory, liquid surfaces, electrons at metal surfaces, electromagnetic surface excitations, surface spectroscopy, and electrical transport in the space-charge region. A separate abstract was prepared for the paper on electrons at metal surfaces. (DLC)

For an abstract of an individual paper see: 30139.

29952 (STI/PUB-396(Vol. 2)) SURFACE SCIENCE. Volume II. Proceedings of a Conference Held in Trieste, Italy, 16 January–10 April 1974. (International Atomic Energy Agency, Vienna (Austria)). 1975. 302p. (CONF-740139-P2). IAEA $19.00.

From international meeting on surface science; Trieste, Italy (16 Jan 1974).

Nine papers are included on atoms and molecules of surfaces (H chemisorption on metals, atomic scattering, survey of chemisorption), biological membranes, and applied surface science (electrode reactions and corrosion, friction, ion bombardment and implantation, applied catalysis, and static electrification). Separate abstracts were prepared for two papers. (DLC)

For abstracts of individual papers see: 30140 and 30264.

29953 STATIC ELECTRIFICATION, 1975. Proceedings of the Fourth Conference on Static Electrification Held in London, 5–8 May 1975. Blythe, A. R. (ed.). Conference Series Number 27. London; Institute of Physics (1975). 318p. (CONF-750581–).

From 4th conference on static electrification; London, UK (5 May 1975).

Twenty-eight papers were presented at the conference on electrostatics in fluids, electrostatics in solids, uses of electrostatics in industry, and electrostatic hazards. An abstract was prepared for one paper for inclusion in NSA (JRD)

For an abstract of an individual paper see: 29970.

Ceramics and Cermets

Refer also to abstracts 28310, 28379, 28430, 28431, 28830, 30082, 30121, 30144, 30150, 30175, 30210, 30212, 30285, 31004, 31026, 32281, 32318, and 32532.

29954 (AD/A-004998) VARIATION OF FRACTURE MIRROR RADIUS WITH FRACTURE STRESS FOR POLYCRYSTALLINE CERAMICS UNDER VARIOUS LOADING CONDITIONS. Technical Report. Kirchner, H. P.; Gruver, R. M.; Sotter, W. A. (Office of Naval Research, Arlington, Va. (USA)). Nov 1974. Contract N00014-74-C-0241. 93p. NTIS $4.75.

The results of fracture mirror measurements on a wide variety of ceramic materials fractured in flexural tests at various temperatures and in delayed fracture and impact tests at room temperature are presented. Much of this work was done by fractographic observations on alumina, silicon nitride, zircon, steatite, and silicon carbide specimens fractured in an earlier investigation of flaws at fracture origins. (GRA)

29955 (AD/A-005270) PRODUCTION ENGINEERING MEASURES TO MANUFACTURE SUPER FINE FINISH BERYLLIA. Quarterly Progress Report No. 2, 1 Oct-31 Dec 1974. Rees, G. H. (Brush Wellman, Inc., Elmore, Ohio (USA)). 29 Jan 1975. Contract DAAB07-74-C-0606. 26p. (BW-TR-557). NTIS $3.75.

See also AD/A-001815.

Surface finishes of four microinches and smoother have been attained by polishing standard Thermalox 995 for substrates using three micron diamond paste. A range of polishing pressures and times have been found acceptable. The input beryllia ceramic surfaces may be previously polished or as fired. (GRA)

29956 (AD/A-005980) ELECTRICAL AND THERMOEMISSION PROPERTIES OF ALLOYS OF LANTHANUM AND CERIUM HEXABORIDES WITH TRANSITION METALS. Samsonov, G. V.; Paderno, Yu. B.; Bondarenko, V. P.; Kovenskaya, B. A. 15 Nov 1974. Translation of Redkozemelnye Metally i ikh Soedineniya (sic), v70, p119-128, Naukova Dumka, Kiev, USSR, 1970. (FSTC-HT-23-179-75). 14p. NTIS $3.25.

Resistivity and thermo-EMF are studied for lanthanum and cerium hexaboride alloys containing from 0.5 percent to 15 percent W, Ta, Re, or Hf. With increasing transition-metal concentration, resistivity first decreased sharply and then gradually increased. Addition of elements capable of raising the proportion of atoms with stable d_0 and d_5 configurations can markedly improve the thermoemission properties of rare-earth hexaborides. (GRA)

29957 (AD/A-008081) AN ANALYSIS OF CHARPY IMPACT TESTING AS APPLIED TO CEMENTED CARBIDE. Technical Information Series Report. Lueth, R. C. (General Electric Co., Detroit, Mich. (USA), Metallurgical Products Dept.). 21 Aug 1972. 27p. NTIS $3.75.

The impact energy or impact strength of WC-Co alloys is currently determined by loading an unnotched ¼ inch x ¼ inch x 2 inch sample in three point bending. This is done on a Charpy Impact tester of 24 ft lb capacity (Model CIM-24, Manlabs, Inc.). The results of these tests are generally considered to be an indication of the "toughness" of cemented carbide. However, much of the field experience where carbide is subjected to impact loading, such as in mining, does not correlate well with the charpy impact values of the various grades of cemented carbides. In an effort to better understand the nature and the limitations of impact testing, the test was studied in detail via instrumentation of both the tester and the specimen. (GRA)

29958 (BNL-20719) RADIATION DAMAGE OF NONMETALLIC SOLIDS. Goland, A. N. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 29p. (CONF-751164-1). Dep. NTIS $4.00

From conference on radiation damage in metals; Cincinnati, Ohio, United States of America (USA) (9 Nov 1975).

A review of data and information on radiation damage in nonmetallic solids is presented. Discussions are included on defects in nonmetals, radiation damage processes in nonmetals, electronic damage processes, physical damage processes, atomic displacement, photochemical damage processes, and ion implantation. (JRD)

29959 (NBL-277, pp 29-30) COMPUTER SIMULATION OF HTGR FUEL MICROSPHERES USING A MONTE-CARLO STATISTICAL APPROACH. Hedrick, C. E. Feb 1976.

In annual progress report, July 1974–June 1975. (Energy Research and Development Administration, New Brunswick, N. J. (USA). New Brunswick Lab.).

The concept and computational aspects of a Monte-Carlo statistical approach in relating structure of HTGR fuel microspheres to the uranium content of fuel samples have been verified. Results of the preliminary validation tests and the benefits to be derived from the program are summarized. (auth)

29960 (TRG-Report–2680(S), pp 23-25) BORON CARBIDE: AN EXAMPLE OF UNEXPECTED DIFFICULTIES IN X-RAY POWDER DIFFRACTION. Ferguson, I. F.; Hughes, T. E. Sep 1975.

From 22nd UKAEA diffraction analysis conference; Dounreay, United Kingdom of Great Britain and Northern Ireland (UK) (15 Oct 1974).

In role of diffraction and electron analysis in the fast reactor programme. (UKAEA Reactor Group, Springfields).

Problems in using the International Tables for Crystallography, for interpreting B_4C powder data are described. They were solved by predicting the multiplicities for all the Laue groups based on hexagonal and trigonal symmetries, using the author's own program. (DLC)

29961 THEORETICAL STUDY OF THERMALLY-INDUCED DIFFUSION: APPLICATION TO HYDROGEN DIFFUSION IN ZIRCONIUM AND OXYGEN DIFFUSION IN UO_2 AND $(U,Pu)O_2$. de la Tijera, J. S. (Instituto Nacional de Energia Nuclear, Mexico City). pp 2 of Thermodynamics of Nuclear Materials 1974. Proceedings of a Symposium Held by the IAEA at Vienna, 21-25 October 1974. Vienna; IAEA (1975).

From symposium on the thermodynamics of nuclear materials; Vienna, Austria (21 Oct 1974). (International Atomic Energy Agency, Vienna (Austria)).

The thermal diffusion of hydrogen in zirconium is discussed on the basis of three models: irreversible thermodynamics, the Wirtz model and Girifalco's model; previous results are analyzed on this basis. Finally the thermal diffusion of oxygen in UO_2 and $(U,Pu)O_2$ solutions is analyzed on the basis of the same criteria. (auth)

29962 PLASMA SPRAYING EFFECT ON BORON AND SILICON CARBIDE FIBERS. Shorshorov, M. Kh.; Kudinov, V. V.; Antipov,

V. I.; Katinova, L. V. Fiz. Khim. Obrab. Mater.; No. 5, 59-61 (1974). (In Russian).

The effect of an argon plasma jet on boron and silicon carbide fibers, both uncoated and coated with B_4C or SiC, was studied. When the fibers were placed in a plasma jet escaping to the atmosphere, the boron fiber strength decreased. By regulating the action of the plasma on the fiber and using a protective coating, it was possible to decrease or even eliminate the weakening effect. (tr-auth)

29963 CONDUCTIVITY OF ZIRCONIUM DIOXIDE STABILIZED BY CALCIUM OXIDE. Liventsov, V. P.; Luzgin, V. P.; Frolov, A. G.; Yavojskij, V. I. (Moskovskij Inst. Stali i Splavov (USSR)). Izv. Vyssh. Uchebn. Zaved., Chern. Metall.; No. 11, 14-18(1974). (In Russian).

For English translation see the journal Stal USSR.

Equipment for studying the nature of the conductivity of solid oxide electrolytes by an emf method is described, and results are presented from a study of the effect of temperature and oxygen partial pressure on the fraction of the ionic component of the conductivity of zirconium dioxide stabilized with calcium oxide. (tr-auth)

29964 NEW RESEARCH OF THE SYSTEM ZrO_2-Al_2O_3-SiO_2. Cevales, G. (Padua Univ. (Italy). Instituto di Impianti Chimici; Consiglio Nazionale delle Ricerche, Padua (Italy). Centro di Studio sulle Reazioni alle Alte Temperature e alle Alte Pressioni). Ber. Dtsch. Keram. Ges.; 52: No. 10, 319-321(Oct 1975). (In German).

The ternary system ZrO_2-Al_2O_3-SiO_2 up to a maximum of 24% SiO_2 has been studied by determining the melting surfaces and the eutectical curves. The ternary eutectic has been found to have the composition 50.9 Al_2O_3, 32.8 ZrO_2, 16.3 SiO_2 (in weight), while the melting temperature was 1,685 ± 5°C. Some of the system mixtures, analyzed by x-ray, have shown quite a variation of the lattice constants of baddeleyit and corundum. (DE)

29965 THEORETICAL EQUATION FOR THE DIFFUSION-CONTROLLED IRRADIATION CREEP OF CERAMIC NUCLEAR FUELS: EFFECTS OF STOICHIOMETRY AND SOLUTE DRAG. Gittus, J. H. (UKAEA Reactor Group, Salwick). pp 2 of Thermodynamics of Nuclear Materials 1974. Proceedings of a Symposium Held by the IAEA at Vienna, 21-25 October 1974. Vienna; IAEA (1975).

From symposium on the thermodynamics of nuclear materials; Vienna, Austria (21 Oct 1974). (International Atomic Energy Agency, Vienna (Austria)).

The creep of both metallic and ceramic materials accelerates when they are irradiated or fissioned in a reactor. Of various theories for the irradiation creep of metals and alloys, one has recently been put forward which promises to systematize a significant proportion of the extant experimental data. The present paper extends this theory. A very general model of the dislocation-creep process is used, based on one which has successfully rationalized the out-of-reactor creep of a number of solids, including UO_2. According to the present development of this model, irradiation increases the dislocation-density until the rate at which the dislocation-network coarsens becomes high enough to produce a compensating reduction in the dislocation-density. The driving force for network-coarsening is the dislocation-line tension and the coarsening rate given by the Einstein equation relating the drift of the climbing dislocations to the relevant diffusion coefficient D_v. The theoretical equation has been solved for pure stoichiometric UO_2 under irradiation. An irradiation-creep rate of about 2 elastic deflections per displacement per atom is predicted and this is in reasonable agreement with the results of experiment. One can go on to examine the kinds of prediction which the equation produces for conditions which have not been explored experimentally. These include the effects of stoichiometry, which alters D_v, and of solute-drag. It is shown that, generally speaking, a change in stoichiometry or solute concentration which accelerates the out-of-reactor creep rate by a factor S, theoretically accelerates the in-reactor creep rate by a factor $S^{\frac{1}{2}}$. (auth)

29966 MAGNETO-OPTIC STUDY OF THE CRITICAL REGION OF EuS. Berkner, D. D. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., A; 54: No. 5, 396-398(6 Oct 1975).

Critical exponents of the insulating ferromagnet europium sulfide are determined using the technique of Faraday rotation. Values obtained are gamma equals 1.06 +- 0.05, beta equals 0.335 +- 0.01, delta equals 4.20 +- 0.1 and T/sub c/ equals 16.52 +- 0.02°K. The data are found consistent with the scaling hypothesis. (auth)

29967 MECHANISM FOR THE FORMATION OF RADIATION CENTERS IN GLASS ACCORDING TO EPR DATA. Cherenda, M. R.; Yudin, D. M. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 5, 87-90(1975). (In Belorussian).

Experimental data are reported on the effects of γ and neutron irradiation on oxide glasses of simple composition. The role of oxygen bridges in the processes of formation of radiation paramagnetic centers in the glass is discussed. (tr-auth)

29968 PHASE TRANSFORMATION PLASTICITY IN ZIRCONIUM-HYDROGEN ALLOYS. Nuttall, K.; McCoeye, D. P. (Chalk River Nuclear Labs., Ont.). pp 129-140 of Mechanical Behavior of Materials. Volume II. Kyoto; Society of Materials Science, Japan (1974).

From symposium on mechanical behavior of materials; Kyoto, Japan (21 Aug 1974). See CONF-740847-P2.

The effect of thermal cycling under load on the mechanical behavior of crystal bar zirconium containing 200 ppM hydrogen was studied. The results indicate that a permanent strain ~0.1% occurs on each complete cycle through the $\alpha + ZrH_2 \rightarrow \alpha$ phase boundary, and that the strain is directly proportional to the applied stress. Cycling to different maximum temperatures showed that the strain is also related to the volume fraction of hydride precipitate which dissolves and reprecipitates during the cycle. The results are discussed in terms of recent internal stress models for phase transformation plasticity. It is proposed that high internal stresses arise due to the volume change associated with hydride formation and from the anisotropy of thermal expansion in zirconium. (auth)

29969 MICROHARDNESS AND PHOTOMECHANICAL EFFECT OF GALLIUM ARSENIDE MONOCRYSTALS IRRADIATED BY FAST NEUTRONS. Sirota, N. N.; Kurilovich, N. F.; Berezina, G. M. (Inst. of the Physics of Solids and Semiconductors, Minsk). Dokl. Akad. Nauk BSSR; 19: No. 10, 880-882(Oct 1975). (In Russian)

The effect of fast neutron irradiation on the microhardness and photomechanical effect (PME) (effect of light on the microhardness) of unalloyed gallium arsenide monocrystals of the n-type ($n = 2 \times 10^{17}$ cm^{-3}) was studied in irradiations at 70 and 140°C. It was shown that the microhardness of GaAs increases very intensely in the presence of irradiation, reaching saturation. An increase of the irradiation temperature from 70 to 140°C leads to a very sharp increase. The PME of irradiated crystals passes through a maximum with increase of the fast neutron dose. In samples irradiated at 140°C the maximum lies at lower neutron doses, but its value is higher than in samples irradiated at 70°C. (tr-auth)

29970 INFLUENCE OF THE CRYSTALLIZATION PROCESS STIMULATED BY IONIZING RADIATION ON DUST ELECTRIFICATION OF PHOTOSENSITIVE GLASS. Szaynok, A. T.; Sycinska-Trojniak, A.; Malcher, J. (Instytut Fizyki, Wroclaw). pp 95-103 of Static Electrification, 1975. Blythe, A. R. (ed.). London; Institute of Physics (1975).

From 4th conference on static electrification; London, UK (5 May 1975). See CONF-750581-.

Dust electrification measurements of photosensitive glass irradiated with either ultraviolet radiation or x-rays have been carried out. The development of the latent image formed in the glass samples by ionizing radiation was performed by heat treatment. The crystallization of glass is connected with this process of development. The phase transition from the amorphous to the crystalline state causes the inner structure of the material to change. These changes strongly influence the electrification of dust produced in the investigated material by mechanical crushing. (auth)

29971 TAILORED DOMAIN PATTERNS IN PIEZOELECTRIC CRYSTALS. Newnham, R. E.; Miller, C. S.; Cross, L. E.; Cline, T. W. (Pennsylvania State Univ., University Park). Phys. Status Solidi (a); 32: No. 1, 69-78(16 Nov 1975).

Twinning is generally considered to be a nuisance which degrades the performance of piezoelectric oscillators, but this need not be so. Domain configurations can be designed to enhance certain modes of motion, or to eliminate others. Experiments on crystals of gadolinium molybdate and lead germanate have been performed to demonstrate the feasibility of the tailored-domain concept. Multi-domain crystals and ceramics can also be used as high-frequency resonators and as focused acoustic transducers. (auth)

29972 ELECTRON TUNNELING THROUGH SEMICONDUCTING BARRIERS. Mehbod, M.; Thijs, W.; Bruynseraede, Y. (Univ., Louvain, Belgium). Phys. Status Solidi (a); 32: No. 1, 203-211(16 Nov 1975).

Metal-doped semiconductor-metal tunnel junctions for which the tunneling barrier is made of a double Schottky barrier are proposed and studied both experimentally and theoretically. Using the tunneling barrier model, the electron tunneling current is calculated. The junctions are prepared by successive condensation from vapor of a Pb electrode, a CdS layer, and a second Pb elec-

trode. The thickness of the semiconducting layer is varied from 50 to 5000 Å. The I–U characteristics of the junctions are measured at liquid helium temperature and prove to be in good agreement with the theory proposed. (auth)

29973 CONTINUUM THEORY OF DOMAIN WALLS IN $Gd_2(MoO_4)_3$. Fouskova, A.; Fousek, J. (Inst. of Physics, Prague). Phys. Status Solidi (a); 32: No. 1, 213-219(16 Nov 1975).

A continuum theory for domain walls perpendicular to a tetragonal a-axis in $Gd_2(MoO_4)_3$ is presented. The spatial dependence of the transition parameters within the wall region, the wall energy, and the energy to wall thickness ratio are calculated as functions of the coefficients in the free energy expansion. The relationship between the features of the model and the known experimental data of the wall properties is discussed. (auth)

29974 ANISOTROPY BEHAVIOR OF U_3P_4. Sima, V.; Sternberk, J.; Sechovsky, V.; Smetana, Z. (Charles Univ., Prague). Phys. Status Solidi (a); 32: No. 1, K59-K62(16 Nov 1975).

Results of magnetic measurements on monocrystalline samples of U_3P_4 at various temperatures between 78 and 300°K are reported. A relatively high uncertainty in determining the anisotropy constant for this compound was found. It is concluded that either the collinear model of the magnetic state is valid or in the case of a non-collinear magnetic structure a field of 12 kOe is able to rotate the magnetic moment only, but is unable to change the relative positions of the magnetic moments of the individual sublattices. (JRD)

29975 ABSORPTION SPECTRA OF NEODYMIUM ION IN $LiYO_2$ SINGLE CRYSTALS. Antonov, V. A.; Arsenev, P. A. (Inst. of Energetics, Moscow). Phys. Status Solidi (a); 32: No. 1, K71-K74(16 Nov 1975).

The absorption spectra of $Li_{Y_{0.98}}Nd_{0.02}O_2$ were measured at 25 and −195°C. Results are tabulated and presented in charts. The crystals were optically transparent in the whole spectral interval. When the samples were exposed to γ radiation, the crystals acquired a slightly red coloring and two wide absorption bands appeared. These bands are the result of γ-generated capture electrons by the Li^+ ion, forming color centers. (JRD)

29976 KINETIC ANALYSIS OF BORON CARBIDE SINTERING. Borchert, W.; Kerler, A. R. (Technische Univ. Muenchen (F. R. Germany). Inst. fuer Geologie und Mineralogie). Metall; 29: No. 10, 993-1002(Oct 1975). (In German)

6 figs.; 2 tabs.; 10 refs.

The kinetics of the sintering of boron carbide were investigated by shrinkage measurements with a high-temperature dilatometer under argon atmosphere in dependence on temperature, grain size, and pressure. The activation energies and the reaction mechanisms of the different stages of sintering were determined. (DE)

29977 X-RAY INVESTIGATIONS IN THE SYSTEM U–N–Te. Trojko, R.; Despotovic, Z. (Inst. Ruder Boskovic, Croatia, Yugoslavia). Croat. Chem. Acta; 47: No. 2, 121-125(1975).

The crystal structures of the ternary compounds in the system U—N—Te were investigated. The compounds were prepared in a powder form by reacting UN + X Te ($0.4 \leq X \leq 2.0$). Powdered uranium mononitride, UN, and elementary tellurium were mixed in the desired proportions and subsequently heated at 900 to 1000°C in evacuated and sealed quartz tubes. The powder diagrams were taken with a Philips diffractometer (CuK_α radiation). The crystal structures and lattice parameters of U_2N_2Te and UNTe were found. The structure of UNTe is discussed in more detail; the unit-cell dimensions, atomic parameters, and interatomic distances have been determined. Comparison between the calculated and observed intensity values shows the best agreement for the variable atomic parameters u = 0.165 and v = 0.624. (auth)

29978 PHASE STABILITY IN HAFNIUM OXIDE POWDERS. Bailey, J. E.; Bills, P. M.; Lewis, D. (Surrey Univ., Guildford, Eng.). Trans. J. Br. Ceram. Soc.; 74: No. 7, 247-252(Nov 1975).

The effect of ball-milling on the stability of various phases of hafnium oxide was determined. X-ray diffraction power analysis was used to identify the phases, and the percentage of each phase present was calculated from relative diffraction peak intensities. On milling, the critical crystallite size for transformation from one phase to another was found to depend on impurity level. The effects of impurity and atmosphere on the hafnia phases formed when precipitated hafnium hydroxide was heated were studied. Both metastable cubic and metastable tetragonal hafnia were obtained at room temperature. (auth)

29979 INVESTIGATION OF THE INTERACTION OF PROTECTIVE WELDING BORIDE COATINGS WITH LIQUID FERROUS ALLOYS. Oreshkin, V. D.; Svetiopolyanskii, V. I.; Panasyuk, A. D.; Borovikova, M. S. (Inst. for Problems in the Behavior of Materials, Kiev). Prot. Met. (USSR) (Engl. Transl.); 11: No. 2, 219-221(1975).

Translated from Zashch. Met.; 11: No. 2, 228-231(1975).

The interactions of IVa and VIa subgroup borides with liquid metals and ferrous alloys were investigated. The greatest contact angle θ for the wetting of borides by liquid iron, i.e., the least wetting, was observed with diborides of metals of the IVa subgroup. The value of W_{mol} was about 50 to 80 kcal/mole, which indicated the existence of chemical interaction. The precipitation of metal with an increased microhardness was observed in the contact zone. X-ray analytical data confirmed the dissolution of boron in liquid iron, to form boride. The diborides of metals of the Va subgroup and CrB_2 interacted with liquid iron to form complex ternary compounds of the type Me^1Me^2B, for which the angle θ was about 10 to 15°. The borides of molybdenum and tungsten (Mo_2B_5 and W_2B_5) were actively wetted by liquid iron, but the formation of new chemical compounds was not observed. (auth)

29980 PULSE-REVERSAL MEASUREMENTS ON FERROELECTRIC-FERROELASTIC $Gd_2(MoO_4)_3$ SINGLE CRYSTALS (GMO). Kuersten, H. D.; Blumberg, H. (Zentralinstitut fuer Optik und Spektroskopie, Berlin). Phys. Status Solidi (a); 31: No. 1, K1-K4(16 Sep 1975). (In German)

The pulse reversal method was used to study both the reversal processes at various field strengths and in both polarization directions of the crystal. Typical curves are given to show the delay time from the imposition of the electrical field up to the beginning of the reverse pulse and the irregular increase of the reverse pulse up to a maximum value. Measurements of the reverse time were made in both polarization directions. The effect of pulse reversal on domain velocity is analyzed. (JSR)

29981 EFFECT OF THERMAL NEUTRON-INDUCED DAMAGE ON PHOTOLUMINESCENCE IN CdTe. Barnes, C. E. (Sandia Labs., Albuquerque, NM); Kikuchi, C. Radiat. Eff.; 26: No. 1-2, 105-111(Sep 1975).

The effects of lattice damage produced by prompt γ-induced ^{114}Cd recoil on the photoluminescence at 9°K in CdTe have been studied. All the observed photoluminescence bands decreased in intensity after thermal neutron irradiation. Following exposure to large thermal neutron fluences the exciton recombination in both n- and p-type CdTe is dominated by two bound exciton bands at 1.574 eV and 1.589 eV. These bands are attributed to excitons trapped at native defect-associated acceptors. The edge emission in these crystals usually occurs as a doublet with the low energy member (donor–acceptor pair) dominant in n-type and the high energy member (free electron-to-bound hole) dominant in p-type. However, after irradiation the high energy peak is always dominant in both n- and p-type CdTe. This is attributed to an increase in the ratio of the number of native defect acceptors, common to both the low and high energy members, to the number of donors that participate in the low energy emission. Similar to the low energy edge emission, the 1.45 eV emission band, due to a native defect acceptor–donor complex, decreases following irradiation. These results can be interpreted on the basis of a recoil model in which Cd defects are produced at a greater rate than Te defects. (auth)

29982 Nb–H SOLVUS: A DISCUSSION. Westlake, D. G. (Argonne National Lab., IL). Scr. Metall.; 10: No. 1, 75(Jan 1976).

Differences between the data of the author (Trans. TMS-AIME 245: 287(1969)) and that of Whitton et al. (Scripta Met. 9: 851 (1975)), which was obtained using the channeling of 1-MeV He ions, are discussed. (DLC)

29983 LATTICE SOFTENING AND ANISOTROPY AT ^{119}Sn SITES IN $SnMo_6S_8$. Kimball, C.W.; Weber, L.; Van Landuyt, G. (Northern Illinois University, DeKalb, Illinois 60115); Fradin, F.Y.; Dunlap, B.D.; Shenoy, G.K. Phys. Rev. Lett. 36: No. 8, 412-415 (23 Feb 1976).

The vibrational motion of Sn in the high—critical-field superconductor $SnMo_6S_8$ has been studied with the ^{119}Sn Mössbauer effect. The Mössbauer thermal shift and recoil-free fraction are found to contain large anharmonic contributions from the soft modes. The soft vibrational motion contributes substantially to the mass enhancement λ. (auth)

29984 FERMI-SURFACE MEASUREMENTS IN NORMAL AND SUPERCONDUCTING 2*H*-$NbSe_2$. Graebner, J.E.; Robbins, M. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. Lett. 36: No. 8, 422-425 (23 Feb 1976).

Landau quantum oscillations are observed for the first time in the layered, superconducting, incommensurate-charge-density-wave compound 2*H*-$NbSe_2$. The oscillations are observed clearly above H_{c2} but also below H_{c2}, with somewhat increased scattering. This is interpreted as scattering of the orbiting normal electrons from the flux lattice. The

observed sheet of Fermi surface can be explained if Mattheiss's augmented-plane-wave band structure is modified slightly. (auth)

29985 CHARGE-DENSITY WAVES AND SUPERCONDUCTIVITY IN $NbSe_2$. Huntley, D.J. (Physics Department, Simon Fraser University, Burnaby, British Columbia, Canada V5A 1S6). Phys. Rev. Lett. 36: No. 9, 490-491 (1 Mar 1976).

A review of the experimental evidence indicates that a recent suggestion by Morris that there is a connection between superconductivity and charge-density waves in $NbSe_2$ is incorrect, and that, if anything, the presence of a charge-density wave has a small inhibitive effect on superconductivity in this material. (auth)

29986 MORPHOLOGICAL AND ELECTRICAL PROPERTIES OF rf SPUTTERED Y_2O_3-DOPED ZrO_2 THIN FILMS. Greene, J.E.; Wickersham, C.E.; Zilko, J.L. (University of Illinois, Urbana, Illinois 61801); Welsh, L.B.; Szofran, F.R. J. Vac. Sci. Technol. 13: No. 1, 72-75 (Jan 1976).

The structural, compositional, and electrical properties of rf sputter-deposited Y_2O_3-doped ZrO_2 films have been investigated as a function of sputtering conditions. The results show that the application of an rf substrate bias during deposition has a large effect on both the morphological and electrical properties of the films. Auger electron spectroscopy, electron diffraction, and scanning-electron-fractography results show that films deposited at $P=20$ mTorr (2.67 Pa), $V_T=-500$ V, and $V_S=-40$ V are nearly stoichiometric, have a cubic crystal structure, and a relatively equiaxed microstructure. The results of electrical measurements indicate that films grown under these sputtering conditions have an ionic transference number which is nearly zero below 100 °C and rises to approximately 0.4 at 200 °C. (auth)

29987 ACTIVATION OF THIN FILM Zn_2SiO_4 PHOSPHORS USING ION IMPLANTATION TECHNIQUES. Hurd, J.M.; Johnston, R.E. (Tektronix, Beaverton, Oregon 97077). J. Vac. Sci. Technol. 13: No. 1, 410-413 (Jan 1976).

The feasibility of using ion implantation as a means of doping Zn_2SiO_4 phosphor is investigated. Thin film structures of Zn_2SiO_4 are synthesized using two methods: (1) direct e-beam evaporation of undoped pressed powder pellets and (2) the solid state reaction of evaporated ZnF_2 on a thermally grown SiO_2 layer. The resultant films are characterized using SEM and AES techniques. The evaporated films show severe zinc depletion while the reacted films show uniform stoichiometry throughout the thickness of the film. Ion implantation is used to activate the films using Mn^+. Ion energies from 20–200 keV and doses from 5×10^{13} to 5×10^{15} ions/cm^2 are investigated. The resultant cathodoluminescent characteristics are studied with respect to anneal temperature, ion dose, and ion energy. Cathodoluminescent film efficiencies are found to be comparable to other thin film phosphor systems. (auth)

29988 SYNTHESIS AND CHARACTERIZATION OF YTTRIUM OXIDE (Y_2O_3) DEPOSITS. Colen, M.; Bunshah, R.F. (Materials Department, School of Engineering and Applied Science, University of California, Los Angeles, California 90024). J. Vac. Sci. Technol. 13: No. 1, 536-539 (Jan 1976).

The synthesis of yttrium oxide (Y_2O_3) was accomplished by evaporating elemental yttrium in the presence of oxygen. High-rate physical vapor deposition was employed using both the reactive evaporation (RE) and activated reactive evaporation (ARE) processes. The ARE process resulted in a higher Y_2O_3/Y ratio for two reasons—more complete reaction and fewer globules of Y being ejected from the molten pool and landing on the deposit surface. The microstructure and mechanical properties of the deposit produced varied with the deposition temperature in accordance with the structural zone model of Movchan and Demchishin. Over a deposition temperature range of 121° to 721 °C, the surface energy, as determined by Hertzian fracture, varied from 645 erg/cm^2 to 515 erg/cm^2, and the microhardness varied from 320 kg/mm^2 to 502 kg/mm^2. (auth)

29989 ESR AND ENDOR STUDIES OF HOLES TRAPPED AT CATION VACANCIES IN BeO. Maffeo, B.; Hervé, A. (Laboratoire de Résonance Magnétique, Centre d'Etudes Nucléaires de Grenoble, Cedex 85, 38041 Grenoble Gare, France). Phys. Rev. B 13: No. 5, 1940-1959 (1 Mar 1976).

The V^- center (cation vacancy with a trapped hole) has been identified by ESR and electron-nuclear double resonance (ENDOR) in neutron- and electron-irradiated BeO crystals. At liquid-helium temperature, the defect is observed in two distinct configurations labeled "axial" and "nonaxial" where the hole is localized on an anion situated either along the $\vec{c}$ axis from the vacancy or on one of the three other corners of the tetrahedron, respectively. This model of an O^- ion next to a vacancy is supported by an analysis of the $\vec{g}$ tensor. At room temperature, the hole jumps from one anion site to another around the vacancy, giving an isotropic averaged ESR spectrum. For the axial V^- center, ENDOR measurements were made at 1.5 °K of the hyperfine interactions with the ^{9}Be nuclei which are nearest neighbors of the O^- ion and with two shells of next-nearest-neighbor nuclei. An analysis of the dipolar magnetic interaction with these nuclei gives detailed information about the electronic structure of the ground state of the defect and the lattice distortions in its vicinity. A comparison between the ENDOR spectra of the nonaxial V^- center and the V^0 center (cation vacancy with two trapped holes) confirms the close relation between these two defects. V^- centers associated with a trivalent impurity B^{3+} have been observed in γ-irradiated BeO crystals. (auth)

29990 IRRADIATION-INDUCED PRECIPITATION IN Ni-Si ALLOYS. Barbu, A.; Ardell, A. J. (CEN de Saclay, Gif-Sur-Yvette, France). Scr. Metall.; 9: No. 11, 1233-1237(Nov 1975).

The characteristics of radioinduced precipitates in Ni–Si alloys are described and mechanisms of their formation are discussed. A hypothesis is offered that the nucleation and propagation of the Shockley partial is diffusion assisted in high-temperature irradiation environments in such a way that the propagation proceeds as soon as the Si atoms diffuse to non-nearest-neighbor violating sites. In this way, a mixed faulted and perfect loop structure observed can be rationalized. (J RD)

29991 EFFECTS OF COOLING RATE ON THE MICROSTRUCTURE AND HARDNESS OF TiC-VC ALLOYS. Hannink, R. H. J. (CSIRO, Melbourne); Murray, M. J. Scr. Metall.; 9: No. 11, 1271-1276(Nov 1975).

A study has been made of the effect of cooling rate from 1350°C on the microstructure and microhardness of well characterized TiC–26 wt percent VC and VC–22 wt percent TiC, with carbon to metal ratio close to 0.84. For the VC–22 wt percent TiC alloy it has been found that as the cooling rate is decreased the room temperature microhardness is also decreased, vacancy domain contrast becomes optically resolvable and a second phase is precipitated. At room temperature domain size hardening is thought the most likely origin of the strengthening. A reduction in cooling rate of TiC–26 wt percent VC alloys results in a significant increase in the room temperature microhardness but no visible change in the optical microstructure, when viewed by either normal or plane polarized white light. The electron microscope observations, of the VC–22 wt percent TiC alloy, previously reported and the present results suggest that above 1350°C the mechanical properties cannot be related to a two-phase microstructure, as had tentatively been suggested in an earlier study. (auth)

29992 PREPARATION OF ZIRCONIUM OXIDE-BASED SOLID SOLUTIONS WITH ELECTRONIC CONDUCTIVITY. Shvaiko-Shvaikovskii, V. E.; Keler, E. K.; Leonov, A. I.; Popov, V. P. (Inst. of Silicate Chemistry, Leningrad). Dokl. Chem. (Engl. Transl.); 222: No. 4-6, 390-391(Jun 1975).

Translated from Dokl. Akad. Nauk SSSR; 222: No. 6, 1350-1352(Jun 1975).

Ti, Nd, and Ce oxides were added to ZrO_2–Y_2O_3 in an attempt to prepare a material which exhibits electronic conductivity in addition to the desired properties of ZrO_2. Solid solutions containing added Ti underwent a monoclinic tetragonal transition at 1100 to 1200°K, which resulted in partial destruction of the samples; those containing Nd oxide exhibited a relatively small fraction of electronic conductivity. Electronic conductivity of Ce oxide-containing solid solutions was studied as a function of Ce and Y oxide content and temperature. (JGB)

29993 PRODUCTION CONDITIONS OF HIGHLY PURE CARBIDE FUEL AND THE BEHAVIOR OF OXYGEN AND CARBON IMPURITIES IN THE PRESENCE OF FISSION PRODUCTS. Kotel'nikov, R. B.; Belevantsev, V. S.; Bashlykov, S. N.; Titov, G. B.; Zelyanin, V. A.; Anuckhin, A. M. At. Energ. (USSR); 39: No. 4, 255-259(Oct 1975). (In Russian).

The conditions for obtaining UC of low oxygen content have been determined by thermodynamic analysis. The mass-transfer mechanism in a UO_2–C system has been investigated. The interaction between oxygen and carbon impurities and fission product stimulators has been studied and changes under irradiation in oxygen and carbon contents have been estimated.

29994 LUMINESCENCE AND CHARGE COMPENSATION IN SnO_2–Tb^3. Crabtree, D. F. (Huddersfield Polytechnic, Eng.). J. Phys., D (London); 8: No. 17, 2097-2102(1 Dec 1975).

The photoluminescence, cathodoluminescence, and thermoluminescence of SnO_2 crystals doped with Tb and charge compensators such as Li, H, or P have been investigated. The characteristic Tb^{3+} lines appear in all cases under electron bombardment. Only SnO_2–Tb–P crystals produce the characteristic Tb^{3+} emission under 365 nm excitation. Otherwise a broad orange band appears, due to the presence of tin vacancies. The traps which appear on adding Tb^{3+} are discussed in terms of a simple model which is used to show that the charge compensation mechanism results in the creation of traps rather than defect luminescence centers. (auth)

29995 SUBSOLIDUS STRUCTURE OF THE SYSTEM HfO_2–ZrO_2–CaO. Gavrish, A. M.; Sukharevskii, B. Ya.; Zoz, E. I.

(Scientific-Research Inst. of Refractories, Kharkov). Dokl. Chem. (Engl. Transl.); 222: No. 4-6, 383-385(Jun 1975).

Translated from Dokl. Akad. Nauk SSSR; 222: No. 6, 1343-1345 (Jun 1975).

X-ray techniques were used to investigate the subsolidus structure of the system HfO_2-ZrO_2-CaO. Isothermal sections of the phase diagram at 1500, 1750, 1900, and 2100°C are given. (JGB)

29996 LOW-ENERGY ABSORPTION EDGE IN 2H-MoS_2 AND 2H-$MoSe_2$. Goldberg, A. M.; Beal, A. R.; Levy, F. A.; Davis, E. A. Philos. Mag.; 32: No. 2, 367-378(Aug 1975).

The optical transmission of thick samples of 2H-MoS_2 and 2H-$MoSe_2$ has been measured below the A exciton energy for each material. The absorption coefficients have been calculated, and the low absorption starting at 1.1 to 1.2 eV has been attributed to an indirect d-d valence band for both materials. There appears to be considerable d-p valence band overlap giving rise to further higher absorption before the strong A, B excitons, which have been associated with direct transitions from a p-like valence band. An energy band scheme has been sketched on the basis of these interpretations.

29997 ATHERMAL CHARACTER OF THE WUERTZITE TRANSFORMATION IN BORON NITRIDE. Kurdyumov, A. V. Fiz. Tverd. Tela; 17: No. 8, 2469-2471(Aug 1975). (In Russian).

The formation of the würtzite phase from normal graphite-like BN on applying high pressures was studied theoretically and experimentally, and the nature of the transformation was analyzed. The transformation occurred both under shock conditions and as a result of the application of a steady pressure; the mechanism was largely athermal and resembled the martensite transformation in Fe. The steady pressure required for the transformation was ~120 kbar, the exact value depending on temperature. Theory and experiment agreed closely on this figure. Increasing the temperature tended to reduce the threshold pressure.

29998 STATE OF FERRITES AFTER EXPOSURE TO HIGH-ENERGY RADIATION. Dersch, W. (Siemens A. G., Muenchen (F.R. Germany). Unternehmensbereich Bauelemente). Siemens Rev.; 41: No. 6, 282-284(Jun 1974).

SIFERRIT toroidal cores were exposed to reactor radiation simulating a dose of 5×10^8 cJ/kg (1 cJ/kg = 1 rd) in the center of the inner Van Allen belt. Measurements of the properties critical to the area of application showed that devices built around ferrite cores are able to withstand extreme radiation.

29999 RADIATION-ENHANCED DIFFUSION OF ION-IMPLANTED BISMUTH IN CADMIUM SULPHIDE. Armitage, S. A. (Oxford Univ.). J. Phys., D (London); 8: No. 17, 2034-2042(1 Dec 1975).

Ion implantation is expected to offer, at best, shallow high-resistivity p-type surface layers on CdS. It is shown that a substantial increase in the width of practical implanted layers is required to raise the efficiency of a light emitting device based on such p-n junctions. Defect enhanced diffusion has been investigated as a means of increasing the width of Bi-implanted layers in CdS. Nitrogen backscatter techniques have been used to determine impurity profiles, and significant impurity movement has been observed following 50 keV ^4He irradiation at 400°C. This movement is however insufficient to meet device requirements. (auth)

30000 INFLUENCE OF CALCIA ADDITION ON SINTERING BEHAVIOUR OF ZIRCONIA. Dalvi, P. Y.; Moorthy, V. K. (Bhabha Atomic Research Centre, Bombay (India). Metallurgy Div.). Trans. Indian Ceram. Soc.; 23: No. 3, 33-38(May 1974).

The influence of the amount of calcia addition on the sintering characteristics of zirconia and the physical properties of the sintered products has been studied. It was noticed that the optimum amount of calcia addition was 0.50 to 0.75 wt% to obtain high density without cracking of the ware. Higher additions of calcia invariably resulted in lowered density. The extent of stabilization was studied by x-ray diffraction and dilatometry. Though the stabilization (conversion of the cubic structure) was not obtained with 0.50 and 0.75 wt % addition of calcia, and the presence of hysteresis loops in the dilatometric curves was noticed in the samples sintered at temperatures up to 1500°C, they were found to have sufficient thermal shock resistance to be used as refractory ware. (auth)

30001 SOLID STATE INFORMATION FROM MAGNETIC HYPERFINE INTERACTION STUDIED IN-BEAM. Reckngagel, E. (Freie Univ. Berlin (F. R. Germany). Fachbereich Physik). Phys. Scr.; 11: No. 3-4, 208-214(Mar 1975).

From conference on hyperfine interaction studies by nuclear reactions and decay; Uppsala, Sweden (10 Jun 1974). 43 refs.

Perturbed angular distribution methods (PAD) following nuclear reactions have been employed to study hyperfine interactions in solids. Special properties of these in-beam techniques are discussed. The large number of nuclear probes, the inherent time scale given by the lifetimes of the excited states, the independence of the alignment on macroscopic parameters and other features, allow investigations which are able to compete with other methods or are even exclusive. Measurements of magnetic hyperfine interactions such as hyperfine fields, critical exponents, or Knight shifts are reviewed and discussed with regard to the specific properties. (auth)

30002 THERMOLUMINESCENCE PROPERTIES OF PURE Al_2O_3. Basu, A. S.; Ganguly, A. K. (Bhabha Atomic Research Centre, Trombay, India). pp 345-356 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The thermoluminescence properties of pure Al_2O_3 are studied with regard to TL glow curve, growth and saturation of the different TL peaks, range of linearity, activation energies, room temperature decay, and spectral properties of each peak. Al_2O_3 has been found to respond to UV radiation in a manner similar to its response to gamma radiation. Apart from the sample of pure Al_2O_3, other samples of Al_2O_3 are also taken, synthetic as well as naturally occurring. Their glow curves and emission spectra have been studied and compared with those of pure Al_2O_3.

30003 THERMOLUMINESCENCE OF $CaCO_3$: Dy AND $CaCO_3$: Mn. Bapat, V. N.; Nambi, K. S. (Bhabha Atomic Research Centre, Bombay). pp 606-614 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

$CaCO_3$ samples doped with Dy and Mn were prepared in the laboratory by co-precipitation techniques. Thermoluminescence and emission spectra of these phosphors were studied and were compared with those of the naturally occurring calcite and undoped $CaCO_3$ samples. Dy doping seems to give a more efficient phosphor and indicates a possibility of getting a better phosphor by a judicious choice of a rare earth doping of $CaCO_3$. Interesting results have been obtained on the TL glow curve variations of these phosphors with different temperature treatments prior to irradiation.

30004 CHARACTERIZATION AND HIGH-TEMPERATURE PHASE RELATIONS OF $3La_2O_3 \cdot WO_3$ AND $5La_2O_3 \cdot 2WO_3$. Yoshimura, M.; Rouanet, A.; Sibieude, F. (CNRS, Montlouis, France). High Temp. - High Pressures; 7: No. 2, 227-234(1975).

The system $La_2O_3-WO_3$ was studied in detail by solid state reaction, fusion, annealing and high-temperature x-ray diffraction. Two cubic fluorite-related phases have been found: $3La_2O_3 \cdot WO_3$ and $5La_2O_3 \cdot 2WO_3$. The 3 : 1 compound has a C-type bcc structure. The new compound, 5 : 2, was identified as a pyrochlore-related fcc structure. The 3 : 1 compound is stable above 1740°C up to the melting point. Below 1740°C it decomposes into the 5 : 2 compound and La_2O_3. The 5 : 2 compound is stable up to 1780°C, and appears to decompose into the 3 : 1 compound and the 3 : 2 compound at higher temperatures. (auth)

30005 TEN YEARS OF X-RAY INTERFEROMETRY. Hart, M. (Univ. of Bristol, Eng.). Proc. R. Soc. (London), Ser. A; 346: No. 1644, 1-22(14 Oct 1975).

X-ray interferometers were the first optical instruments which utilized many Bragg reflecting components in monolithic blocks of perfect crystal. They have made important contributions to knowledge of fundamental constants, of Bragg reflexion x-ray optics, of strains and defects in crystals, and of the optical constants of materials in the x-ray region of the electromagnetic spectrum. Based on an oversimplified optical analogue, their mode of operation is described in detail. Current applications of crystal interferometers and possible future work is briefly reviewed.

30006 ϵ-EXPANSION ANALYSIS OF SOME PHYSICALLY REALIZABLE $N \geq 4$ VECTOR MODELS. Letter to the Editor. Mukamel, D.; Krinsky, S. (Brookhaven National Lab., Upton, NY). J. Phys., C (London); 8: No. 22, L496-L500 (21 Nov 1975).

Four different $n \geq 4$ component Hamiltonians are derived describing phase transitions in certain physical systems. The corresponding critical behavior is studied using the exact renormalization group in $d = 4$ dimensions. In particular, although TbD_2, Nd, and K_2IrCl_6 have different symmetries, their critical behavior is described by the same anisotropic $n = 6$ Hamiltonian and is predicted to correspond to the same fixed point. For three of the Hamiltonians it is found that there exists no stable fixed point. (auth)

30007 POSSIBILITY OF GROWING SINGLE CRYSTALS OF SILICON CARBIDE FROM VAPOR. Smiltens, J. (Air Force

Cambridge Research Labs., L. G. Hanscom Field, MA). High Temp. - High Pressures; 7: No. 2, 187-198(1975).

From the dissociation pressure curve, the equation for the rate of raising the pressure of the binary vapor for obtaining the required linear growth rate of the crystal is derived. It is shown that the rate is nearly proportional to the vapor pressure. Literature data for the dissociation pressure of silicon carbide are compared with the values calculated from the existing thermodynamic functions of silicon carbide, graphite, and several molecular species in the binary vapor. Only polycrystalline boules consisting of large grains have so far been obtained, but with certain technological improvements it might be possible to grow single-crystal boules. The relationship between the pressure of the binary vapor in the sublimation bottle and the measured gage pressure is studied. (auth)

30008 β-PHASE MELTING AND SOLIDIFICATION PHENOMENA IN THE NIOBIUM–HYDROGEN SYSTEM. Schober, T.; Wenzl, H. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (a); 33: No. 2, 673-681(16 Feb 1976).

The morphology of the decomposition and formation (or the melting and solidification in the lattice gas description) of the ordered NbH β-phase is investigated with polarized light and interference contrast techniques. Melting occurs in the absence of temperature gradients by the growth of droplets of the liquid phase α′ nucleated at the domain boundaries. Solidification of the α′-phase involves the formation of single-domain β-phase plates, subsequent repeated twinning and the growth of "elastic closure domains". The solidus and liquidus lines of the $\beta \rightarrow \alpha'$ transformation are determined in the range from 70 to 95 at.% H/Nb, where the transition temperatures vary from 84 (triple line of α, α′ and β-phase) to 145°C. (auth)

30009 METAL-SEMICONDUCTOR PHASE TRANSITION IN VANADIUM OXIDES AND TECHNICAL APPLICATIONS. Chudnovskii, F.A. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Tech. Phys. 20: No. 8, 999-1012 (Aug 1975).

Existing theories for the metal-semiconductor phase transition which are pertinent to this transition in vanadium oxides are reviewed. The best model for interpreting the phase transition in V_2O_3 is the model proposed by Aronov and Kudinov, in which the phase transition is attributed to an instability which arises in the subsystem of Frenkel' excitons. Experimental data supporting this point of view are reported. In vanadium dioxide the most probable explanation for the phase transition seems to be an instability of lattice vibrations, but effects due to an electron-electron interaction are also manifested experimentally. The observed metal-semiconductor phase transition in the series $V_nO_{2n-1}(n=3\text{-}9)$ is not related to a change in magnetic order. Many of the properties in this series, e.g., the magnetic properties, can be understood assuming that the V^{3+} ion is in cleavage planes and that the V^{4+} ion is in rutile blocks between these planes. The metal-semiconductor phase transition in vanadium oxides is used in automation and control applications (in thermistors with a "critical point") and can be used in microelectronics and opto-electronics. (auth)

30010 PREPARATION METHOD OF BORON SUBOXIDE B_2O. Cueilleron, J.; Jean-Blain, H. (to Agence Nationale de Valorisation de la Recherche (ANVAR), 92–Paris-Defense (France)). French Patent 2,241,495/A/. 13 Jul 1973. 6p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

Boron is oxidized in an oxygen stream in the presence of a boride of platinum or of a metal of the same group at temperatures from 1250 to 1400°C, care being taken to use as refractory support a material not likely to react with boron at such temperatures. In particular, to boron can be added platinum in the finely divided states, which is transformed into boride towards 100 to 110°C by using a plate of mullite. The platinum can be recovered later on by treating the product with ebullient dilute sulfuric acid. This can be applied to the manufacture of very hard cutting-edge tools, of refractory walls adapted to resist oxidization up to about 1400°C and even of neutron-shields used in certain atomic experiments.

30011 SIMULATION OF THE COSMIC CORPUSCULAR RADIATION EFFECTS ON OPTICAL MATERIALS. Akishin, A. I.; Bessonova, T. S.; Prokofiev, I. P.; Teplov, I. B.; Tokarev, G. A.; Tseplyaev, L. I. pp 515-524 of Evaluation of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of space environment on materials; Toulouse, France (17 Jun 1974).

Ionization processes induced in optical materials by cosmic corpuscular radiations cause radioluminescence, radiation coloration, and changes in elastic properties of optical materials. Implanted electric charge is accumulated when optical materials exhibiting dielectric properties are irradiation by charged particles. Such effects, using as an example one of the widely used group of optical materials, namely the silicate optical glasses were studied.

30012 METHODS FOR SIMULATING THE SPACE EFFECTS OF THERMAL CONTROL COATINGS. Akishin, A. I.; Vernov, S. N.; Guzhova, S. K.; Soloviev, G. G.; Tarasov, Yu. I.; Titov, V. I. pp 591-602 of Evaluation of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of space environment on materials; Toulouse, France (17 Jun 1974).

The work is mainly devoted to simulation of the effects of cosmic radiations in the remote and close vicinities of the earth on the external materials of space vehicles. The report describes a set of installations designed for studying the changes in thermal control coating optical properties when the effects of the various cosmic factors are simulated. Since in natural conditions thermal control coatings are simultaneously affected by a complex of different factors, the installations were designed to include this fact.

30013 NEUTRON DIFFRACTION DETERMINATION OF MAGNETIC ORDER IN METALLIC PYRITE $NiS_{1.4}Se_{0.6}$. Plumier, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique); Krill, G. (Strasbourg-1 Univ., 67 (France)). J. Phys. (Paris), Lett.; 36: No. 10, L.249-L.250(Oct 1975). (In French)

In the metallic pyrite $NiS_{1.4}Se_{0.6}$ an ordered non collinear, antiferromagnetic structure is observed, analogous to the one determined in $MnTe_2$. The existence of this phase is in good agreement with the Mott-Hubbard theory. At 4.2°K, the observed magnetic moment of Ni is 0.59 μB.

30014 SPACE CHARGE LIMITATION OF THE CURRENT IN IMPLANTED SiO_2 LAYERS. Szydlo, N.; Poirier, R. (Thomson-CSF, Domaine de Corbeville, 91–Orsay (France)). pp 155-160 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French)

From 4th international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces No. 171.

Metal-oxide-semiconductor capacitors were studied where the metal is a semitransparent gold layer of 5mm diameter, the oxide is thermal silica whose thickness depends on the nature of the implant, and the semiconductor is N-type silicon of 5 ohms/cm. The SiO_2 thickness was chosen in such a way that the maximum of the profile of the implanted substance is in the medium of the oxide layer. In the case of virgin silica, the oscillations in the photocurrent versus energy and exponential variations versus the applied voltage show that the photoconduction obeys the model of injection limited current. In the case of the oxide after ion bombardment, the photocurrent similarity, independent of the direction of the electric field in silica, shows that volume transport phenomena become preponderant.

30015 ION IMPLANTATION USE FOR ADJUSTING THE THRESHOLD VOLTAGE OF MESFET INTENDED FOR ULTRA-FAST LOGICS. Arnodo, C.; Nuzillat, G. (Thomson-CSF, Domaine de Corbeville, 91–Orsay (France)). pp 192-198 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French)

From 4th international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces No. 171.

Ion implantation allows very thin channel MESFET to be made on silicon. Thresholds such obtained are very low and even sometimes positive (normally-off transistors). Such transistors with ultra-short grids (0.5 μm), are involved in designing ultra-fast integrated logic circuits with low power consumption (T(pd) < 1ns and P < 200 μW for instance). A numerical approach allows refining of the effect of threshold voltage spread on the time duration of propagation. Delineations necessary in fabricating these circuits are effected by electronic masking.

30016 USE OF A SCANNING ELECTRON MICROSCOPE FOR CHARACTERIZING SEMICONDUCTOR DEVICES. Borel, J.; Bresse, J. F.; Carme, H.; Monnier, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). pp 329-337 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French)

From 4th international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces No. 171.

The electron beam from a scanning microscope was used three different ways: (1) in induced mode for characterizing the substrate of a P^+N junction by measuring the diffusion length and in controlling surface recombination velocities; (2) for controlling Si/SiO_2 interface degradation by measuring very low frequency capacitance and for evaluating the oxide quality by measuring μ/τ: the evolution of the current of an avalanche photodiode; (3) in using the beam as a casting probe for determining features of the generation volume such as Si thickness on Al_2O_3.

30017 LATTICE VIBRATIONS IN LEAD SELENIDE. Vijayaraghavan, P. R.; Iyengar, P. K. (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.); Sinha, S. K. (Iowa State Univ. of Science and Technology, Ames (USA)). pp 208-210 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, December 27-31, 1973. Vol. 16C. Solid State Physics. Bombay; Department of Atomic Energy (1974).

From nuclear physics and solid state physics symposium; Bangalore, India (27 Dec 1973). 6 refs.

As a part of a program to study the effect of carrier concentration on the dispersion curves of narrow band-gap semiconductors, single crystals of lead selenide have been grown using the Bridgman technique with a descent speed of ~4 mm/hour, with the samples sealed under vacuum in quartz capsules. Coherent inelastic neutron scattering experiments to determine the frequency-wavevector relations for phonons propagating along high symmetry directions have been done on one such sample and the measurements have been completed for the acoustic branches. Measurements on the optic branches are underway. The neutron data, together with the optical measurement at zero wavevector has been analyzed on the basis of the shell model of Woods, Cochran, and Brockhouse. (auth)

30018 ISOTHERMAL COMPRESSIBILITY OF ThS AND ThSe UP TO 200 Kbar. Govind Rajan, K. (Reactor Research Centre, Kalpakkam (India)); Krishnan, A.; Sequcira, A.; Venkataraman, G. (Bhabha Atomic Research Centre, Bombay (India)). pp 160 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bangalore, December 27-31, 1973. Vol. 16C. Solid State Physics. Bombay; Department of Atomic Energy (1974).

From nuclear physics and solid state physics symposium; Bangalore, India (17 Dec 1973).

The isothermal compressibility, K_T, at 25°C, of the actinide chalcogenides ThS and ThSe, up to 200 Kbar, was measured using a diamond anvil high pressure x-ray camera. Both ThS and ThSe are metallic at zero pressure, and possess the NaCl structure in the range of pressures investigated. Neither of them exhibit the NaCl-CaCl transformation up to 200 Kbar, unlike the rare earth calcoginides. Also, their compressibilities are much less than those of the alkali halides and rare earth chalcogenides, being in fact close to that of iron. Their values are found to be: K_T for ThS = $(4.51 \pm 0.7) \times 10^{-4}(\text{kbar})^{-1}$ and K_T for ThSe = $(7.55 \pm 0.7) \times 10^{-4}(\text{kbar})^{-1}$. (auth)

30019 MATHEMATICAL MODEL OF THE COLD PRESSING OF CERAMIC POWDERS, AND THE RELATIONSHIP OF PRESSING TO SINTERING BEHAVIOR. Rado, T. A.; Halko, J. E. (Kerr-McGee Corp., Oklahoma City, OK). Sci. Sintering; 7: No. 3, 203-220(Dec 1975).

A study of UO_2 powders has been carried out to derive a mathematical model of the pressing behavior of the powder, and relate it to the subsequent sintering behavior of the green compacts. By use of a soil mechanics analogy, equations are derived which permit calculation of required pressing conditions, the work done during pressing, and the particle size of the powder in the green compacts after pressing. This is related to the sintering behavior of the compact by empirical relationships previously reported in the literature. Using these techniques, behavior of a particular powder in the pressing and sintering process can be determined with a minimum amount of test work.

30020 THERMIONIC CHARACTERISTICS OF PURE AND YTTRIUM-CONTAINING ZIRCONIUM CARBIDE. Samsonov, G. V. Porosh. Metall., Akad. Nauk Ukr. SSR; No. 8, 68-71(Aug 1975). (In Russian)

The thermionic characteristics of ZrC and a wide range of alloys belonging to the Zr-C-Y system were studied. The work-function in particular was practically independent of the method of producing the carbides (subject to approx. constant chemical composition). The emission mechanism and the level of the work-function were mainly determined by the conditions of heat treatment. In the case of ZrC-Y alloys, high-temperature heat treatment led to the formation of extensive areas of pure Y on the surface of the alloy, which tended to reduce the work-function. When the Me-C binding energy was increased by changing the stoichiometry or incorporating additives, the formation of a metal film on the surface was impeded.

30021 MAGNETIC TRANSFORMATION IN THE SYSTEM $Mn_{3-x}Ni_xB_4$. Novogrudskii, V. N.; Timoshchuk, V. I.; Fakidov, I. G.; Burkhanov, A. M. Fiz. Tverd. Tela; 17: No. 8, 2506-2507(Aug 1975). (In Russian)

The nature of the magnetic transformation already known to exist in $Mn_{3-x}Ni_xB_4$ compounds for x values between 0.06 and 0.36 (Hirota, J. Phys. Soc. Jpn., 1966, 21, 433; M. A., 1966, 1, 1586) is discussed. Measurements of magnetization in a field of 11 kOe, the electrical resistance, and the coefficient of linear expansion indicate that the exchange-inversion mechanism initially proposed for this transformation is invalid, since it would imply a sharp change in dimensions at the transformation point; no such change was observed. The data suggest that the transformation is of the second kind; it evidently takes place in a magnetically-inhomogeneous system.

30022 EXPLANATION OF THE QUESTION OF STABILITY OF HEXAGONAL PRIMITIVE TIN-RICH PHASES. Predel, B.; Gerdes, F. (Univ., Stuttgart). J. Less-Common Met.; 45: No. 1, 23-36(Feb 1976). (In German)

In order to analyze the factors influencing the stability of hexagonal, tin-rich phases, thermoanalytic and x-ray investigations of a number of polynary systems, based on Sn-In-Tl have been carried out. In addition to the influence of the difference of the atomic radii, the structural difference between the alloy components on the one hand, and the hexagonal phase on the other, is important in relation to their stability. An estimate of the transformation enthalpy for the hypothetical change from white tin into a hexagonal-primitive modification gave $\Delta H^U_{Sn} < 0.14$ kcal $(\text{g atom})^{-1}$.

30023 DEEP TRAP MEASUREMENT ON S^+-IMPLANTED LAYERS IN GaAs. Yokoyama, N.; Ohkawa, S.; Sakurai, T.; Furuya, T.; Ishikawa, H. (Fijitsu Laboratories Limited, 1015, Kamikodanaka, Nakahara-ku, Kawasaki, Japan). Appl. Phys. Lett. 28: No. 7, 405-407 (1 Apr 1976).

GaAs substrates were implanted with sulfur at 100, 200, 300 °C, and at room temperature and annealed at 800 °C with SiO_2 or Si_3N_4 protective layers. The density and activation energy of deep traps in the implanted layers were determined from transient capacitance measurements. It is found that implantation at 200 °C and annealing with a Si_3N_4 film as a protective layer yields the lowest trap density in the implanted layer. (auth)

30024 RANGE PROFILES OF 6-16-keV HYDROGEN IONS IMPLANTED IN METAL OXIDES. Bøttiger, J.; Leslie, J.R.; Rud, N. (Institute of Physics, University of Aarhus, DK-8000 Aarhus C, Denmark). J. Appl. Phys. 47: No. 4, 1672-1675 (Apr 1976).

The range profiles of 6-16-keV hydrogen ions implanted in the amorphous metal oxides Al_2O_3, Nb_2O_5, Ta_2O_5 have been measured. The profiles were determined by use of the nuclear reaction $^1H(^{19}F,\alpha\gamma)^{16}O$. Good agreement with theoretical predictions is observed for the most probable ranges, while the widths of the experimental distributions are substantially larger than theoretically calculated for Al_2O_3 and Nb_2O_5. (auth)

30025 POINT DEFECTS IN HEXAGONAL BORON NITRIDE. III. EPR IN ELECTRON-IRRADIATED BN. Andrei, E.Y.; Katzir, A.; Suss, J.T. (Solid State Physics Department, Soreq Nuclear Research Center, Yavne, Israel). Phys. Rev. B 13: No. 7, 2831-2834 (1 Apr 1976).

A new paramagnetic center was produced by 550-kV electrons in hexagonal boron nitride. It is shown that this center is a three-boron center and consists of an electron trapped in a nitrogen-ion vacancy (*F* center). The hyperfine interaction was found to be anisotropic with $A_\perp = 40.0 \pm 0.5$ G and $A_\parallel = 45.3 \pm 0.5$ G for the interaction with ^{11}B nuclei. The *g* factor was found to be $g = 2.0020 \pm 0.0008$. The thermal stability of this center was investigated. (auth)

30026 THERMODYNAMIC STUDY OF STRUCTURAL AND SUPERCONDUCTING TRANSITIONS IN A V_3Si SINGLE CRYSTAL. Viswanathan, R. (Brookhaven National Laboratory, Upton, New York 11973); Johnston, D.C. Phys. Rev. B 13: No. 7, 2877-2879 (1 Apr 1976).

Reported here is a direct comparison of the thermodynamic properties of the tetragonal and cubic phases of a single crystal V_3Si based on our ac heat-capacity data obtained before and after arresting the structural transformation by copper cladding. Whereas the bulk superconducting temperatures are the same to within 0.1 K, the entropy of the tetragonal phase at the transformation temperature (~ 20 K) is greater than that of the cubic phase by ~ 240 ± 50 mJ/mole K. (auth)

30027 VIBRATIONAL-MODE SHIFTS IN INELASTIC ELECTRON TUNNELING SPECTROSCOPY: EFFECTS DUE TO SUPERCONDUCTIVITY AND SURFACE INTERACTIONS. Kirtley, J.; Hansma, P.K. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. B 13: No. 7, 2910-2917 (1 Apr 1976).

Measurements of the effect of the top metal electrode on the vibrational-mode energies of benzoic acid on alumium oxide with Pb, Sn, and Ag top metal electrodes are described. Peak shifts of approximately 15 meV for the O-H stretch modes of hydroxyl ions, 0.5 meV for the C-H bending modes, and less than 0.2 meV for the C-C ring stretch and bend modes of benzoate molecules were found. These measurements are discussed in terms of a simple image model. For junctions with superconducting electrodes a modulation-dependent correction must be made to the measured peak positions. A theory is developed for the line shapes and peak positions of both the second and third harmonic signals and compared with experiment. (auth)

30028 MAGNETIC SUSCEPTIBILITY OF MIXED-VALENCE RARE-EARTH COMPOUNDS. Varma, C.M.; Yafet, Y. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 13: No. 7, 2950-2954 (1 Apr 1976).

Many rare-earth compounds (e.g., Sm chalcogenides, $YbAl_3$) exhibit temperature-independent magnetic susceptibility at low temperatures in their mixed valence phase despite the fact that the ionic configuration in at least one of the valences is such as to lead to a Curie-Weiss behavior. An essential feature of these compounds is that the Fermi level is pinned to the *f* levels. We first examine the effect of this feature in the Anderson model for an isolated impurity and find through a strong-coupling variational wave function as well as through a simple Green's-function treatment that the susceptibility is finite at $T \rightarrow 0$ °K and of order μ^2/Γ where Γ is the virtual width of the *f* level corrected for correlation effects. For the compounds, a two-band ("*f*" and "*d*" with orbital degeneracies neglected) Hubbard-like model leads in the same treatment to a finite susceptibility at $T = 0$, where now Γ is essentially the *f-d* hybridization energy. Order-of-magnitude agreement with experiments is obtained with a reasonable value of the *f-d* mixing interaction. The physics of the finite susceptibility at $T = 0$ is the renormalization of the local moments by the conduction electrons which is strongest when the *f* levels are at the Fermi level. (auth)

30029 STRUCTURAL DISTORTIONS IN THE LOW-TEMPERATURE PHASE OF NbO_2. Pynn, R.; Axe, J.D. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973); Thomas, R. Phys. Rev. B 13: No. 7, 2965-2975 (1 Apr 1976).

At about 810 °C niobium dioxide undergoes an apparently second-order transition between a high-temperature (HT) rutile structure and a low-temperature (LT) phase whose structure is slightly distorted from rutile. The primary order parameters of the transition are the amplitudes of sinusoidal displacement waves with wave vectors $\vec{q}_p \equiv (1/4, \pm 1/4, 1/2)$. These waves give rise to a series of superlattice reflections in diffraction patterns obtained with the LT phase. Additional superlattice reflections occur at wave vectors which are related by the rutile point group to $\vec{q}_m \equiv (1/2, 1/2, 0)$ and $\vec{q}_x \equiv (1/2, 0, 0)$. The latter reflections may be diffraction harmonics or they may represent the presence of secondary distortions in the LT phase. A detailed neutron diffraction study at room temperature has allowed the LT structure to be determined and has demonstrated that both primary and secondary distortions are required for an adequate description of this phase. The general symmetry properties of the primary distortion are discussed and this distortion is described in terms of a simple model involving dimerization of *c*-axis chains of Nb atoms. (auth)

30030 EFFECTS OF ELECTRICALLY INACTIVE ION IMPLANTATION IN $GaAs_{1-x}P_x$ ($x \simeq 0.38$) ON PHOTOLUMINESCENCE INTENSITY. Okabayashi, H. (Central Research Laboratories, Nippon Electric Company, Ltd., Kawasaki, Japan). Appl. Phys. Lett. 28: No. 9, 490-491 (1 May 1976).

The effects of electrically inactive ion implantation in *n*-type $GaAs_{1-x}P_x$ ($x \simeq 0.38$) on photoluminescence intensity have been studied. Improvement of the photoluminescence efficiency for the near-band-gap transition was achieved by a group-III element (B and Ga) ion implantation at 10^{13} cm^{-2}. Group-V element (As) ion implantation led to deterioration of the efficiency to the same degree or more than group-VIII element (Ar) ion implantation. The results suggest that the efficiency improvement is attributed to a decrease in the concentration of the "killer" center, probably associated with the Ga vacancy included in the as-grown GaAsP crystals. (auth)

30031 TEMPERATURE DEPENDENCE OF PHOTOLUMINESCENCE FROM Be-IMPLANTED GaAs. Chatterjee, P.K.; McLevige, W.V.; Vaidyanathan, K.V.; Streetman, B.G. (Coordinated Science Laboratory and Department of Electrical Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). Appl. Phys. Lett. 28: No. 9, 509-512 (1 May 1976).

Photoluminescence data from Be-implanted GaAs are presented for the temperature range 3–120 °K. A luminescence band at 1.493 eV is associated with recombination from the conduction band to neutral Be acceptors, based on the temperature dependence. The binding energy of Be acceptors in GaAs is estimated to be 28.4 meV from the temperature dependence of the peak energy of this band. (auth)

30032 EVIDENCE FOR A CONDUCTION-ELECTRON TRANSITION FROM PRESSURE DEPENDENCE OF NMR IN CeP AND CeAs. Weaver, H.T.; Schirber, J.E. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. B 13: No. 4, 1363-1369 (15 Feb 1976).

Nuclear-magnetic-resonance (NMR) measurements as a function of temperature and pressure have been made of the Knight shift *K* of ^{31}P and ^{75}As contained in CeP and CeAs, respectively. The pressure derivative of *K* ($d \ln K/dP$) for both compounds shows a large increase near the temperature where *K* is known to become nonlinearly related to the susceptibility. Detailed analyses of the NMR data show that behavior expected from either nonlinear hyperfine effects or valence changes of the Ce qualitatively fail to account for the pressure results. It is shown, however, that the effects of a sharp feature in the conduction-electron density of states, located very near the Fermi energy, can produce the observed NMR. The pressure dependence of *K* for ^{31}P in YbP was also studied. Very small pressure-induced changes in *K* occurred at low temperature with no anomalies in the pressure derivative such as observed in the Ce compounds. (auth)

30033 COMPARISON OF INTERFACE-STATE BUILDUP IN MOS CAPACITORS SUBJECTED TO PENETRATING AND NONPENETRATING RADIATION. Winokur, P.S.; Sokoloski, M.M. (Harry Diamond Laboratories, Adelphi, Maryland 20783). Appl. Phys. Lett. 28: No. 10, 627-630 (15 May 1976).

Metal-SiO_2-Si capacitors under positive bias were subjected to penetrating Co^{60} γ and nonpenetrating 10.2-eV uv radiation. High-frequency 1-MHz and quasistatic *C-V* curves were recorded before and after irradiation, and interface-state densities over the Si band gap were calculated from these curves by using the Terman, Berglund, and Castagne techniques. The nature and magnitude of the buildup of interface states were similar for both types of irradiation, demonstrating that the buildup is not related to the direct interaction of radiation at the interface or a structural modification of the SiO_2 layer, but to the production of electron-hole pairs in the oxide and the subsequent transport of holes to the oxide-semiconductor interface. The buildup of interface states under irradiation saturated at $\sim 5 \times 10^5$ rad (SiO_2). (auth)

30034 SURFACE DIFFUSION OF PLUTONIUM ON URANIUM DIOXIDE. Furuya, H.; Koizumi, M. (Power Reactor and Nuclear Fuel Development Corp., Tokai-mura, Japan). Nucl. Technol.; 28: No. 2, 226-234(Feb 1976).

The surface diffusion of plutonium on uranium dioxide was measured from 1400 to 1830°C using a tracer method. A $(U,Pu)O_2$ point source was placed and heated on the polished surface of a UO_2 diffusion pellet. In the low-temperature range from 1400 to 1670°C, the product of the surface diffusion coefficient and high diffusivity surface layer, D/sub s/ , delta, was expressed by the equation D/sub s/ , delta equals 4.33 x 10^{-4} exp (-68,000/RT) cm^3/s (1400 to 1670°C). As the temperature of diffusion anneal increases, transport of some tracer atoms from the point source to the pellet surface appeared. In the temperature range from 1640 to 1830°C, the product, D/sub s/ , delta, was expressed by the equation D/sub s/ , delta equals 2.95 x 10^8 exp (-172,000/RT) cm^3/s (1640 to 1830°C). (auth)

30035 METAMICTIZATION OF LITHIUM NIOBATE BY THERMAL NEUTRONS. Primak, W.; Anderson, T. T. (Argonne National Lab., IL). Nucl. Technol.; 28: No. 2, 235-248(Feb 1976).

Lithium niobate plates intended for application as sensors for acoustical monitoring of reactors were subjected to thermal-neutron irradiation near room temperature. By 8 x 10^{19} n/cm^2, a crystal had become highly disordered, as shown by the back-reflection Laue picture, by loss of piezoelectric response, and by loss of optical birefringence. This transformation appears to be a metamictization. Changes in optical absorption, tritium loss, postirradiation lithium migration, surface crazing, and effects of postirradiation storage at room temperature and of heating to 140°C are also observed. (auth)

30036 THERMAL DIFFUSION OF OXYGEN IN PuO/sub 2-y/. Sari, C. (EURATOM, Karlsruhe, Ger.); Schumacher, G. Nucl. Technol.; 28: No. 2, 256-260(Feb 1976).

Oxygen redistribution in hypostoichiometric plutonium dioxide was investigated in out-of-pile experiments. The heat of transport of oxygen thermal diffusion depends on the O/Pu ratio and increases from 0 to -28 kcal/mole when the O/Pu ratio increases from 1.65 to 1.95. Result is comparable to that obtained with mixed oxides, thus indicating the heat of transport of solid-state thermal diffusion to be independent of plutonium concentration in the mixed oxide. (auth)

30037 DYNAMIC RECRYSTALLIZATION OF ZIRCONIUM CARBIDE. Darolia, R.; Archbold, T. F. (Univ. of Washington, Seattle). Scr. Metall.; 10: No. 3, 251-253(Mar 1976).

Results of compression testing of ZrC are presented which show that in the range 1200 to 1800°C these materials may undergo dynamic recrystallization. The predominant deformation mechanism near the yield stress is carbon diffusion-assisted motion of dislocations. Oscillations appear in the curves for constant strain rate becoming pronounced at 1800°C. The oscillations are attributed to dynamic recrystallization. Successive recrystallization steps appear to be confined to grain boundary regions having adjacent grains yet to be crystallized. (JRD)

30038 HIGH TEMPERATURE PHASE RELATION IN THE SYSTEM La_2O_3–WO_3. Yoshimura, M. (Tokyo Inst. of Tech., Ookayama, Japan). Mater. Res. Bull.; 11: No. 2, 151-158(Feb 1976).

The system La_2O_3–WO_3, especially the La_2O_3-rich portion was studied by a thermal analysis, high temperature x-ray diffraction, annealing of fused samples, solid state reaction, and DTA methods up to the liquidus. Eight intermediate phases, La_2O_3:WO_3 equals 3:1, 5:2, 3:2, 1:1, 7:8, 1:2, 1:3, and 2:9, were found and characterized. In addition, two unquenchable solid solution phases based upon La_2O_3-X and H, have been found. A phase diagram is presented.

30039 SYSTEM V/SUB 1-x/Fe/SUB x/O_2: MAGNETIC PROPERTIES AND STRUCTURE. Pollert, E.; Villeneuve, G.; Menil, F.; Hagenmuller, P. (Univ., Bordeaux). Mater. Res. Bull.; 11: No. 2, 159-166(Feb 1976). (In French).

The system V/sub 1-x/Fe/sub x/O_2 (x less than or equal to 0.020) was investigated by x-ray diffraction, DTA, magnetic susceptibility measurements, and Moessbauer spectroscopy. The phase diagram and the magnetic properties are similar to those of the V/sub 1-x/Cr/sub x/O_2 and V/sub 1-x/Al/sub x/O_2 systems previously studied. In oxygen deficient materials appears a Magneli type shear phase, the Fe^{3+} ions occupying the shear planes.

30040 SOLID-PHASE INTERACTION OF OXIDES OF GROUP II ELEMENTS WITH LEAD DIOXIDE. Fedorov, N. F.; Zagarova, S. A. J. Appl. Chem. USSR (Engl. Transl.); 48: No. 8, 1757-1760 (Aug 1975).

Translated from Zh. Prikl. Khim.; 48: No. 8, 1687-1692(Aug 1975).

Study of solid-phase interaction of oxides of metals of Group II of the periodic system with lead dioxide showed that MeO–PbO_2 systems can be subdivided into two groups in accordance with the character of this interaction: systems without interaction between the original components, such as (MgO, ZnO, or CdO)–PbO_2; and systems in which plumbates are formed, such as (CaO, SrO, or BaO)–PbO_2. The tendency to formation of compounds in MeO–EO_2 systems is determined by the ratio of the crystal-chemical characteristics (ionic radius and ionic potential) or the Me^{2+} and E^{4+} cations. (auth)

30041 VISCOSITY OF MOLTEN VANADIUM(V) OXIDE AT DIFFERENT PARTIAL PRESSURES OF OXYGEN. Musikhin, V. I.; Chernyaev, V. G.; Istomin, S. A. (Inst. of Metallurgy, Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 8, 1147-1150(Aug 1975).

Translated from Zh. Fiz. Khim.; 49: No. 8, 1955-1959(Aug 1975).

A vibrating-red viscosimeter was used to measure the viscosity of molten vanadium pentoxide as a function of the partial pressure of oxygen in the furnace atmosphere. This relation correlates with the corresponding dependence of other properties-electrical conductivity and thermo-emf.

30042 HOLOGRAPHIC MEMORY IN FILMS OF VANADIUM DIOXIDE. Valiev, K. A.; Zakoteeva, I. M.; Mokerov, V. G.; Petrova, A. G.; Rakov, A. V. Dokl. Akad. Nauk SSSR; 222: No. 3, 587-589(21 May 1975). (In Russian).

Because of the pronounced change in optical properties of vanadium dioxide during the semiconductor–metal phase transition, the thermal, "hysteresis", and the amount of phase transition under the effect of laser radiation it is possible to use this material to write, store, and read out optical information. This study presents the results of investigating holograms on VO_2 films, the reading of which was performed at different light wavelengths (λ = 0.53, 0.63, 1.06, and 1.15 μm from lasers LG-36, LG-126, and LTIpCH-3). It was possible to read out polytone images. The material was found to be highly reliable for storing information and reading out information with repeated cycling. (SJR)

30043 EFFECT OF THE IONIZING RADIATION FROM A NUCLEAR REACTOR ON THE PROPERTIES OF γ-ALUMINA MODIFIED WITH URANIUM TRIOXIDE. Bogdanova, E. A.; Nadykto, B. T.; Voloshchik, A. A.; Il'chenko, G. G. Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 8, 1191-1193(Aug 1975).

Translated from Zh. Fiz. Khim.; 49: No. 8, 2035-2038(Aug 1975).

The changes in the surface structure and phase composition of industrial γ-alumina and γ-Al_2O_3 containing 11 wt% UO_3 were investigated by the method of low-temperature nitrogen adsorption, x-ray diffraction, and thermogravimetric analysis after irradiation in a nuclear reactor with an integral stream of thermal neutrons (1×10^{18} neutrons cm^{-2}). Irradiation of γ-Al_2O_3 without UO_3 leads to a uniform increase of the volumes of pores of all sizes. On modification of alumina with uranium trioxide, the pore volume decreases from 0.48 to 0.13 cm^3 g^{-1}. Irradiation of the modified specimens with neutrons leads to an increase of pore volume from 0.13 to 0.18 cm^3 g^{-1}. (auth)

Metals and Alloys

Refer also to abstract 28279.

30044 (ORNL-5117) LIQUID METAL FAST BREEDER REACTOR MATERIALS DEVELOPMENT PROGRAM. Quarterly Progress Report for Period Ending September 30, 1975. Peterson, S. (Comp. and Ed.). (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 187p. AT.

Research activities are reported on steam generator materials development for the CRBR plant, mechanical and metallurgical properties of LMFBR components, high temperature design data, large diameter piping and fittings development, and advanced absorber materials. (JRD)

30045 MECHANICAL BEHAVIOR OF MATERIALS. Volume I. Proceedings of a Conference Held in Kyoto, August 21–24, 1974. Kyoto; Society of Materials Science, Japan (1974). 623p. (CONF-740847-P1).

From symposium on mechanical behavior of materials; Kyoto, Japan (21 Aug 1974).

Papers presented at the conference and included in Part I are concerned with toughness testing, crack propagation, fracture, stress intensity, finite element methods, plastic strain, temperature gradient effects, microvoid formation, fatigue, corrosion, creep, tensile properties, thermal shock, impact strength, and properties of composite materials. (JRD)

30046 MECHANICAL BEHAVIOR OF MATERIALS. Volume II. Proceedings of a Conference Held in Kyoto, August 21–24, 1974. Kyoto; Society of Materials Science, Japan (1974). 532p. (CONF-740847–P2.

From symposium on mechanical behavior of materials; Kyoto, Japan (21 Aug 1974).

Papers presented at the conference and included in Part II are concerned with work-hardening, deformation, yield stress, strains, solid solutions, dislocations, effects of interstitials, radiation damage, plastic properties, phase transformations, creep, thermal stresses, thermodynamic properties, anisotropic materials, composites, and concretes. A separate abstract was prepared for each of five papers selected for inclusion in NSA. (JRD)

For abstracts of individual papers see: 29968, 30141–30143, and 30265.

30047 MATERIALS OF CONSTRUCTION FOR NUCLEAR POWER REACTORS. Nigam, K. D. P. (Bombay Univ. (India). Univ. Dept. of Chemical Technology). J. Inst. Eng. (India), Chem. Eng. Div.; 54: 53-57(Jun 1974).

On account of the prospective economy and because of the dwindling coal resources of the world, all the industrial nations are either building up or planning to build nuclear power stations. The tremendous amount of energy available from a small quantity of fissionable material has led to increasing interest in obtaining power from nuclear fuels. An important aspect of reactor design is the choice of suitable materials for cladding, control rods and shielding. The factors affecting the selection of materials for use in the core of nuclear reactors are similar to those in any engineering application, with additional considerations of radiation effects and conservation of neutrons. The latter, being of overriding importance, has resulted in primary consideration of low cross section materials such as aluminium, magnesium and zirconium. The major factors which affect the selection of materials are (i) corrosion, (ii) compatibility, (iii) physical and mechanical properties, (iv) fabricability, and (v) radiation damage. These factors have been discussed in detail with respect to each material. The final selection is usually based on a compromise to obtain the best combination of physical and mechanical properties, corrosion resistance and stability with respect to the fuel and the fabricability. (INIS)

Corrosion and Erosion

Refer also to abstracts 29961, 30493, 32279, 32385, 32482, 32493, 32510–32512, and 32525.

30048 (AD-783057) HIGH-TEMPERATURE PROTECTIVE COATINGS OF REFRACTORY MELTS (Mo, W, Nb, Ta) AND ALLOYS BASED ON THEM. Byalobzheskii, A. V.; Tsirlin, M. S. Translated by R. E. Zarza from Itogi Nauki Tekh., Korroz. Zashch. Korroz.; 1: 213-264(1971). 73p. NTIS $3.75.

As a result of investigations in the development of high-temperature protective coatings for W, Ta, Mo and Nb, successes are reported. The complex silicide coatings insure the reliable performance of these materials up to temperatures of 1300 to 1800°C; however, their service life thus far is short and at high (above 1400°C) temperatures is limited to 12 hours. For the protection of the big four metals at temperatures above 2000°C ThO_2, HfO_2, and ZrO_2 and cermets on their bases are promising. Investigations are necessary on the thermodynamic properties of the substances which are included in the composition of protective coatings (oxides and silicides) at temperatures on the order of 1500 to 2000°C and higher. (GRA)

30049 (BNWL-tr-164) NEW EXPERIENCE WITH NEUTRAL TRANSPORT. Freier, R. K. 1970. Translation of German Report. (CONF-701083-1). Dep. NTIS $3.50.

From VGB feed water meeting; Essen, German, Federal Republic of (F.R. Germany) (Oct 1970).

Results of tests are reported on additions of oxygen to steel surfaces in neutral salt-free water to form protective oxide surfaces. It was found that solidly adhering oxide protective magnetite films form on steel at temperatures greater than 25°C with a thickness of 0.020 mm and sufficient strength under steam generator operating conditions. Chloride concentrations are, starting at 0.1 mg Cl^-/l, of negative effect (pitting). With oxygen concentrations 20 to 200 mu g O_2/l, natural-law and stable conditions are established in the water–steam cycle on steel, copper, and brass. Cu_2O is relevant for copper coating of high pressure turbines. The appearance of Cu_2O in the high pressure steam is dependent on the oxygen content, the reactions with water, the ammonium content, and the flow rate of the condensate and feed water. (JRD)

30050 (JAERI-M-6100) ENVIRONMENT-ENHANCED CRACK PROPAGATION OF SENSITIZED TYPE 304 STAINLESS STEEL IN SIMULATED BWR ENVIRONMENT. Nakajima, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Apr 1975. 16p. (In Japanese). Dep. NTIS (US Sales Only) $4.50.

A preliminary work on the study of crack propagation of sensitized AISI type 304 stainless steel in simulated boiling water reactor environment is described. Particular stress is placed on the combined effect of cyclic and static stresses, when the material is loaded cyclically with trapezoidal stress wave form of varied holding time at tension. The measurement of propagation was made successful by using the tapered double-cantilever-beam type specimens, which gave a constant stress intensity factor under a fixed load level throughout the test. The effect of chemical environment, therefore, was evaluated by simple comparative examination. The load level and water chemistry were fixed during the test, and the effect of the time at tension was made a variable. For the two dissolved oxygen levels, i.e. low (0.1 ppM) and high (10 to 40 ppM), a strong influence on the mode of cracking was observed. The major findings were; 1) apparent acceleration of crack propagation in 200°C water comparative to the ambient air environment, and 2) change in fracture mode from transgranular (fatigue) to intergranular (stress corrosion cracking) types with either increase of the oxygen content in water or the holding time at tension. The results of measurements were analyzed in terms of the combined effect of the time-dependent stress corrosion and the cycle-dependent corrosion fatigue. (auth)

30051 (NTIS/PS-75/749) HYDROGEN EMBRITTLEMENT OF METALS. A Bibliography With Abstracts. Search Period Covered: 1964–August 1975. Smith, M. F. (National Technical Information Service, Springfield, Va. (USA)). Oct 1975. 285p. NTIS $25.00.

The research covers the hydrogen embrittlement of both ferrous and nonferrous metals and alloys and includes nuclear technology, aircraft metallurgy, mechanical properties, testing, electroplating, fatigue, corrosion and fracture. (Contains 230 abstracts) (auth)

30052 (TT-74-58009) HIGH-TEMPERATURE OXIDATION AND WEAR RESISTANCE OF COPPER DIFFUSION-SATURATED BY ALUMINUM, NICKEL, AND ZIRCONIUM. Vavilovskaya, N. G.; Timonina, L. G. Translated from Zashch. Pokrytiya Met.; 5: 177-179(1971). 7p. (DMDC-14086). NTIS $3.25.

Sponsored in part by National Science Foundation, Washington, D. C. Special Foreign Currency Science Information Program.

The surface of copper specimens were saturated with aluminum, nickel, and zirconium metals by packing the copper in powders of the respective metals (or combinations eq. aluminum and nickel, aluminum and zirconium) and interdiffusing them at temperatures ranging from 850 to 950°C. The resulting interdiffusion zones were studied with microhardness readings, x-rays, and metallographic examination. These same specimens were then oxidized in air at 850°C for 25 hours. The wear resistance and oxidation resistance of the surface-alloyed specimens was greater than the unprotected copper metal. (GRA)

30053 KINETICS OF NIOBIUM INTERACTION WITH DIFFERENT GASES AT LOW PRESSURES AND HIGH TEMPERATURES. Lejn, F. Ya.; Ermakova, M. P.; Nesterenko, A. G.; Martinson, E. N.; Gekov, A. F.; Arakelov, A. G. Fiz. Khim. Obrab. Mater.; No. 5, 27-31(1974). (In Russian)

The kinetics of interaction of Nb with the residual gases in a vacuum was studied for the individual gases and for the mixture at pressures of 1×10^{-4} and 1×10^{-3}mm Hg and temperatures from 400 to 1000°C. The rate of interaction of Nb with the gases in the initial linear part of the kinetic curve increased in the order: N_2, CO_2, H_2O vapor, air, 50% N_2–50% O_2. Reaction coefficients were determined for the conditions used. For the N_2–O_2 mixture, the retarding effect of the passive gas (N_2) resulted in a decrease in the partial pressure of the active gas (O_2).

30054 AUTOCLAVE DEVICE FOR OXIDATION AND CORROSION OF MATERIALS WITH HIGH PRESSURE WATER. Martinez, V. (Goettingen Univ. (F. R. Germany). Inst. fuer Physikalische Chemie); Reymann, A. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany). Inst. fuer Werkstofftechnologie). Werkst. Korros.; 26: No. 9, 703-706(1975). (In German)

The autoclave device is described and operational experience regarding tightness, temperature distribution, and quality of water as well as the results of the corrosion and oxidation tests are given. (DE)

30055 PRUEFUNG VON UNLEGIERTEN UND NIEDRIGLEGIERTEN STAEHLEN AUF BESTAENDIGKEIT GEGEN INTERKRISTALLINE SPANNUNGSRISSKORROSION. (Testing of Unalloyed and Low Alloyed Steels on Resistance to Intergranular Tension Crack Corrosion). DIN Deutsches Inst. fuer Normung e.V., Dortmund (F. R. Germany). Fachnormenausschuss Materialpruefung; (Jul 1975). 2p. (In German). (DIN–50915).

The short-term method stipulated in this standard is aimed at testing unalloyed and low alloyed steels for resistance to intergranular crack corrosion. This method is only to be used on ferritic steels which, in comparison with ordinary steels for building, normally ought to show greater resistance to intergranular tension crack corrosion. This method is not applicable to the testing of welded joints. (DE)

30056 INVESTIGATION INTO CORROSION FATIGUE OF FERRITIC STAINLESS STEELS. Lipp, H. J. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Frankfurt am Main (F. R. Germany). Festigkeitslaboratorium). Werkst. Korros.; 26: No. 11, 825-831(Nov 1975). (In German)

The corrosion fatigue behavior has been studied under cyclic flexural load in air and in concentrated NaCl solutions. The materials of construction used in the test were the steels X 20 Cr 13 and X 20 CrMo 13, and the recently developed steels Inconel X 744 and PV 520 B which are used for turbine blades. The results show that the two last mentioned steels containing, in addition to 26 and 13% Cr respectively, 6 to 7% Ni are characterized by much higher corrosion fatigue resistance (107 cycles). In view of the differences found in the results with respect to the ratio between unnotched and notched specimens in X 20 Cr 13 and X 20 CrMo 13 and in the group Inconel X 744 and PV 520 B the necessity becomes evident of using notched specimens for corrosion fatigue tests. Nitrided surface layers may exert a considerable influence in the case of short test durations, particularly in the case of the steel X 20 CrMo 13. At test durations exceeding some 100 hours, however, the protective effect of the nitrided layers disappears. (DE)

30057 ELECTROCHEMICAL CORROSION OF MOLYBDENUM IN MOLTEN ALKALI-METAL CHLORIDES. Ozeryanaya, I. N.; Zalazinskii, G. G. Tr. Inst. Elektrokhim., Ural. Nauchn. Tsentr, Akad. Nauk SSSR; No. 21, 72-74(1974). (In Russian).

Studies were made of the electrochemical corrosion of Mo in molten NaCl, KCl, and their equimolar mixtures, and in CsCl, at 800 to 950°C under He. The rate of electrochemical corrosion is $\sim10^{-9}$ A/cm² and increases in the order NaCl → KCl → CsCl, the steady-state potential, E, becoming more negative in the same order. The dependencies for E/temperature and E/cation radius were established. (Metals Abstr.)

30058 SPUTTERING OF CHEMISORBED GAS (NITROGEN ON TUNGSTEN) BY LOW-ENERGY IONS. Winters, H. F.;

Sigmund, P. (IBM Res Lab, San Jose, Calif). J. Appl. Phys.; 45: No. 11, 4760-4766(Nov 1974).

Flash filament techniques and mass spectrometry have been used to measure sputtering yields for nitrogen chemisorbed on tungsten and bombarded with noble-gas ions in the energy range up to 500 eV. The experimental results show that primarily nitrogen atoms rather than molecules are sputtered. Despite a high binding energy, high sputtering yields and low threshold energies are found. The results are in reasonable agreement with simple theoretical estimates. It is suggested that, in the investigated energy range, adsorbed nitrogen atoms are sputtered primarily as a consequence of direct knock-on collisions with impinging and/or reflected noble-gas ions. Estimates are also given for the yield of nitrogen atoms knocked off by sputtered tungsten atoms. This latter process is expected to dominate at much higher energies. 23 references.

30059 QUANTITATIVE ANALYSIS OF ALUMINUM ALLOY CORROSION UNDER CONDITIONS OF HEAT TRANSFER. Gerasimov, V. V.; Gromova, A. I.; Denisov, V. G. At. Energ. (USSR); 39: No. 6, 409-411(Dec 1975). (In Russian)

The corrosion stability of aluminum alloy X8001 conditions of heat transfer was determined on the basis of the results obtained in testing aluminum alloys under static and dynamic conditions at various temperatures. A differential equation describing the dependence of the extent of corrosion on testing time is given. It was found that there is a satisfactory correlation between calculated and experimental data on corrosion stability of aluminum alloy X8001 under conditions of heat flux in water of high temperature. (auth)

30060 OPTICAL AND ELECTRON MICROSCOPICAL EXAMINATION OF MOLYBDENUM AND TUNGSTEN. Eck, R. (Metallwerk Plansee A. G., Reutte/Tyrol (Austria)). Prakt. Metallogr.; 12: No. 10, 526-538(Oct 1975). (In English, German)

16 figs.; 13 refs.

The introduction is followed by a discussion of the problem of embrittlement in molybdenum, tungsten and their alloys as a result of the condition of the grain boundaries. In addition to the grain boundary impurities the presence of sintering pores represents an analytical and metallographic problem. The formation of the overlapping fibre structure during the manufacture of tungsten wire serves as an example of the potential of optical and scanning electron microscopy as investigatory methods. (DE)

30061 INTERGRANULAR STRESS CORROSION OF SENSITIZED Cr-Ni-STEELS IN BOILING WATERS. Herbsleb, G. (Mannesmann-Forschungsinstitut G.m.b.H., Duisburg (F. R. Germany)). VGB Kraftwerkstech.; 55: No. 9, 608-613(Sep 1975). (In German)

11 figs.; 9 refs.

Sensitized high-alloyed austenite chromium-nickel steels are susceptible to intergranular stress corrosion in boiling chloride-containing and cloride-free neutral waters under normal pressure. In chloride-containing waters, the susceptibility to intergranular stress corrosion increases with decreasing chloride concentration, increasing strength of the sensitization and with increasing mechanical stress. In chloride-free Na_2SO_4 solutions, it increases with decreasing sulphate concentration. (DE)

30062 REACTION BETWEEN BARIUM AND NITROGEN IN LIQUID SODIUM. Solubility Studies. Addison, C. C.; Pulham, R. J.; Trevillion, E. A. (Nottingham Univ., Eng.). J. Chem. Soc. (London), Dalton Trans.; No. 20, 2082-2085(1975).

Nitrogen in increasing amounts has been added to separate solutions of barium in sodium of constant composition (ca.4.40 mol % Ba) at 300°C. After rendering each mixture homogeneous using an electromagnetic pump, filtration, and nitrogen analysis, all the N_2 added has been found in solution up to a solution composition approximating to Ba_4N (i.e. 1.1 mol % N) beyond which the quantity of dissolved N_2 decreases progressively due to precipitation of the nitride Ba_2N. The solubilization is interpreted in terms of strong preferential solvation of the nitride ion by barium cations. (auth)

30063 INFLUENCE OF THE STRUCTURE AND COMPOSITION OF ALLOYS OF THE Ti-Cr-Ta SYSTEM ON THEIR ANODIC BEHAVIOR. Chernova, G. P.; Kalnina, G. S.; Tomashov, N. D. (Inst. of Chemicophysics, Moscow). Prot. Met. (USSR) (Engl. Transl.); 11: No. 2, 151-155(1975).

Translated from Zashch. Met.; 11: No. 2, 159-164(1975).

An increase in the chromium content in quenched (homogeneous) and annealed (two- or three-phase) alloys increases the anodic currents in the active and passive regions, while an increase in the tantalum content decreases the currents of anodic dissolution. At the potential 1.2 V (the potential of superpassivation of chromium) on the anodic polarization curves of annealed alloys a loop of anodic dissolution is observed, which corresponds to the dissolution of the γ-phase ($TiCr_2$) present in the surface layer of the alloy. (auth)

30064 HIGH-TEMPERATURE OXIDATION OF HAFNIUM-COPPER ALLOYS IN AIR. Voitovich, R. F.; Golovko, E. I. (Inst. of Materials Science, Kiev). Prot. Met. (USSR) (Engl. Transl.); 11: No. 2, 205-208(1975).

Translated from Zashch. Met.; 11: No. 2, 216-219(1975).

Oxidation of Hf-Cu alloys containing 0 to 100 Cu was investigated at 600 to 1200°C. The kinetics of oxidation in air were studied by continuous weighing for 8 h. Appreciable oxidation of hafnium-copper alloys begins at 800°C. The kinetic oxidation curves for Hf + 10% Cu alloy in the 800 to 1000°C range are positioned abnormally; this also occurs in the oxidation of pure hafnium. It appears that the scale on copper-hafnium alloys at 600°C is single-phase and consists of Cu_2O. At 800 and 900°C Cu_2O and CuO form in the outer layer of scale on these alloys and zones of internal oxidation consisting of HfO_2 form in the alloy surface layers, due apparently to the selective oxidation of hafnium in view of the high free energy of formation of HfO_2. Possibly the formation of internal oxidation zones is one of the causes of increased oxidation of Cu-Hf alloys at 800 and 900°C by comparison with pure copper. (auth)

30065 CONSTRUCTION OF A MODEL AND OPTIMIZATION OF THE ANODIZING (ANODIC OXIDATION) OF NIOBIUM. Zakharov, V. V.; Sevryukova, L. M.; Smirnova, V. G. (Tomsk Polytechnic Inst., USSR). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 7, 1094(Jul 1975).

Translated from Zavod. Lab.; 41: No. 7, 856(Jul 1975).

The quality of protective oxide film on the surface of Nb parts is characterized by the following parameters: leakage current, residual current and tangent of the dielectric-loss angle. The independent variables are the forming voltage, the oxidizing current density, the electrolyte concentration, the forming exposure, and the electrolyte temperature. Three quadratic models were constructed using the Hartley plan, and in all these models, the same interactions were found to be significant. Solutions of the models for two local minima with corresponding residual currents are given. The stability of the solutions of each of these minima has been established to yield the final choice of optimum technology. (BLM)

30066 IRON OXIDES IN THE WATER OF STEAM GENERATING EQUIPMENTS OF NUCLEAR POWER PLANTS. Margulova, T. Kh. (Moskovskij Ehnergeticheskij Inst. (USSR)). Kernenergie; 18: No. 5, 126-128(1975). (In German).

The standards for iron oxide content in steam generating equipments of nuclear power plants applied in the USSR, FRG, and USA are critically studied. It is shown that in order to ensure reliable water regime in reactors of direct nuclear power plants the requirement to be met by the reactor water is presence of an unsaturated solution with respect to the iron oxides, i.e., the iron oxide concentration in feed water must not exceed 5 g/kg. The application of electromagnetic filters is proposed. In the steam generators of two-loop nuclear power plants an unsaturated solution may be maintained by microdosage of complexons into the feed water.

30067 ON THE INFLUENCE OF OXIDATION-REDUCTION SYSTEMS ON CORROSION IN THE WATER-STEAM CIRCUIT OF POWER PLANTS. Reinhard, G. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). Kernenergie; 18: No. 6, 170-175(1975). (In German).

Corrosion of steel pipe and vessel materials employed in the water steam circuit of power plants is considered to be a special case of normal corrosion of iron in water. After considering briefly the primary reactions, the influence of oxidation-reduction systems is studied. In this connection the "combination principle" is also discussed that implies chemical passivation of the steel surface by combined action of certain anions of weak acids and oxygen or another oxidant. Finally, influence on redox potential measurements by precipitation of solid corrosion products of iron at the redox electrode is briefly considered. (INIS)

30068 INVESTIGATIONS ON THE ACTIVITY BUILD-UP IN THE PRIMARY CIRCUIT OF PRESSURIZED-WATER REACTORS. 1. Build Up and Composition of the Corrosion Product Layers and Model Corrosion Products of the Steel 1X18H10T. Sachse, G.; Rommel, H.; Mittag, I.; Schlenkrich, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Kernenergie; 18: No. 6, 165-170(1975). (In German).

Starting from the radiation conditions due to radioactivity buildup in the primary circuit of pressurized-water reactors and the corresponding knowledge about this, the necessity of model investigations is discussed. For these investigations of layers of

corrosion products on austenite steel plates, mixed oxides from a solution of this steel in sulfuric acid, and magnetite from ferrous sulphate solution were prepared. The composition of the produced materials was determined by chemical and activation analysis. Information about the build up of the layers was obtained. It is shown that the original layers of the primary circuit in the Rheinsberg PWR are similar to the products prepared which, therefore, are assumed to be suitable for model investigations. (INIS)

30069 CHEMICAL CLEANING OF TUNGSTEN AND MOLYBDENUM. Stamets, R. J. Met. Finish.; 73: No. 7, 29-33 (Jul 1975).

To choose the best cleaning system for refractory metals, it is necessary to have the objective of the operation clearly defined and to plan and design equipment carefully to minimize hazards and environment impact of the highly active agents required. A discussion of cleaning objectives deals with the kinds of material to be removed, surface conditions and requirements. Four major systems for cleaning W and Mo are described, with modifications dictated by the need to attack the base metal or only scale or surface contaminants. A table compares the effectiveness of these systems. Molten salt is most effective on scale while acid solutions present the biggest disposal problem. (Metals Abstr.)

30070 METHOD FOR PROTECTING STEEL FROM CORROSIVE AND IN PARTICULAR FLUORINATED GASES. Clement, R.; Manfredi, P. (Societe de Fabrication d'Elements Catalytiques (SFEC), 84-Bollene (France)); Jocob, M. (CEA, 75-Paris (France)). (to CEA, 75-Paris (France)). French Patent 2,236,017/A/. 2 Jul 1973. 5p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

This method is characterized in that it comprises in combination the steps of spraying an aluminum layer in the hot state onto the steel surface, hammering the coated surface to make it smooth and the pores obturate and finally treating at a temperature lower than the iron-aluminum diffusion temperature. This can be applied to uranium hexafluoride generating plants.

30071 CORROSION BEHAVIOR, MECHANICAL PROPERTIES, AND LONG-TERM AGING OF NICKEL-PLATED URANIUM. Dini, J. W.; Johnson, H. R.; Schoenfelder, C. W. (Univ. of California, Livermore). Nucl. Technol.; 28: No. 2, 249-255(Feb 1976).

The behavior of nickel-plated uranium upon exposure to moist nitrogen was evaluated. Plating thicknesses of 0.051 mm (2 mil) were adequate to prevent corrosion. Specimens with thinner coats showed some corrosion and some reduction in mechanical properties during subsequent testing. Plated samples exposed to dry air at ambient pressure for 10 y showed no corrosion and no degradation of mechanical properties. Surface and bulk hydrogen content, as well as free hydrogen generated during the test, were measured to determine the extent of corrosion. Results support an earlier proposed mechanism for uranium corrosion at low humidities. (auth)

30072 INVESTIGATION OF HYDROGEN PERMEABILITY OF COMMERCIAL IRON AND Kh18N10T STAINLESS STEEL IN CORROSIVE MEDIA. Archakov, Yu. I.; Zvezdin, Yu. I.; Kirillova, V. P.; Malyshev, V. N.; Nazarov, A. A.; Novakovskaya, E. P. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neftekhimicheskikh Protsessov, Leningrad (USSR)). Fiz.-Khim. Mekh. Mater.; 10: No. 5, 92-95(1974). (In Russian).

For English translation see the journal Sov. Mater. Sci.

Experimental data are presented on the hydrogen permeability of commercial iron and stainless steel Cr18Ni10T at a temperature of 700°C, a hydrogen pressure of 1 atm over air and in contact with water vapor. It is shown that the hydrogen permeability of commercial iron and also of stainless steel Cr18Ni10T in a water vapor medium is lower than over air and in vacuum. The smallest hydrogen permeability is shown by samples of stainless steel subjected to diffusion aluminizing in a powder medium. (tr-SJR)

30073 CRACKING OF HIGH-STRENGTH CHROMIUM STEELS IN ELECTROLYTES WITH DIFFERENT pH VALUE. Timonin, V. A. (Moskovskij Inst. Stali i Splavov (USSR)). Fiz.-Khim. Mekh. Mater.; 10: No. 5, 10-16(1974). (In Russian).

From English translation see the journal Sov. Mater. Sci.

A study is made of the character of the time dependence of the cracking of martensitic steels as a function of the pH of a solution of sodium nitrate, and of the transition to hydrogen embrittlement. It is shown that the reason for cracking in natural media is the severe localization of the corrosion process. Cathodic polarization slows down or completely prevents the cracking. The effect of mechanical stresses to the stability of the passive state, and of chemical composition on the corrosion cracking of high-strength steels is indicated. Alloying of martensitic stainless steels with molybdenum effectively increases their resistance to corrosion cracking. (tr-SJR)

Preparation and Fabrication

Refer also to abstracts 28402 and 28613.

30074 (AD/A-005080) PLANAR HIGH-ENERGY PERMANENT MAGNETS. Semiannual Report, 1 Apr-30 Sep 1974. Willson, M. C.; Janowiecki, R. J. (Monsanto Research Corp., Dayton, Ohio (USA)). Jan 1975. Contract DAAB07-73-C-0112. 58p. NTIS $4.25.

See also AD-780085.

Samarium-cobalt permanent magnets were fabricated by arc plasma spraying. The technique is being investigated as an economical method for fabricating cobalt-rare earth magnets for advanced traveling wave tubes and cross-field amplifiers. Plasma spraying permits deposition of material at high rates over large areas with optional direct bonding to the substrate, and offers the ability to fabricate magnets in a variety of shapes and sizes. Magnets were produced with high coercivity and good reproducibility in magnetic properties. Post-spray thermal treatments were used to enhance the magnetic properties of sprayed deposits. Samarium-cobalt magnets, sprayed from samarium-rich powder and subjected to post-spray heat treatment, displayed energy products in excess of 9 million gaussoersteds and coercive forces of approximately 6000 oersteds. Bar magnet arrays were constructed by depositing magnets on ceramic substrates and the axial field profiles of such arrays were determined. Ring magnet fabrication was initiated. (GRA)

30075 (AD/A-008532) GRAIN REFINEMENT OF TITANIUM ALLOYS. Final Technical Report, May 1973-Jun 1974. Buczek, M. J.; Hall, G. S.; Seagle, S. R.; Bomberger, H. B. (RMI Co., Niles, Ohio (USA). Research and Development Dept.). Nov 1974. Contract F33615-73-C-5106. 142p. NTIS $5.75.

The objective of this program was to determine the optimum amounts of yttrium added either as the oxide or element for grain refinement to commercial Ti-6Al-4V and Ti-38-6-44 titanium alloys and establish the effects on subsequent mechanical behavior and sonic inspectability. The properties of cast 8-inch-diameter ingots as well as 3-inch bar processed from these ingots were evaluated at yttrium contents up to 0.1 percent. Nearly all the mechanical property data were obtained on alloys containing 0.03 percent yttrium. At this level, significant grain refinement was not observed in Ti-38-6-44 although improved sonic inspectability, higher transverse ductility, and improved stress-corrosion resistance were observed. At the same 0.03 percent yttrium content, the recrystallized Ti-6Al-4V beta grain size was reduced and improved sonic inspectability and ductility were obtained in wrought and cast products. (GRA)

30076 (ANL-Trans-1034) SURFACE PREPARATION OF NIOBIUM FOR A NICKEL PHOSPHORUS COATING. Zuikova, V. S.; Maslennikov, A. F.; Kvokova, I. M. Translated from Zashch. Met.; 11: No. 1, 118-120(1975). 9p. Dep. NTIS $3.50.

The effects of cathode processing on Nb surfaces and on the quality of bonding of Ni chemically plated on these surfaces were studied. It was found that cathode processing of niobium in an alkaline solution of 5 M KOH +1 M NaCl provides a strongly bonded Ni coating with a thickness of 30 to 40 mcm (with several runs) with a rather high rate of precipitation (3 mcm/hour), together with an increase in catalytic activeness of the surface. Annealing (calcination) at 200°C in air for 2 hours is recommended for improving the bond. A nickel covering of this thickness itself does not provide protection from high-temperature oxidation, but is a reliable intermediate layer below any thick galvanizing coating—for example, nickel-chromium, copper, silver, or gold.

30077 (CEA-CONF-3155) ELECTRON BEAM WELDING OF VERY THICK PART. Martin, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Technologie). 16 Jan 1975. 29p. (In French). INIS.

From 2nd international symposium of the Japan Welding Society; Osaka, Japan (24 Aug 1975).

The welding of a 123mm thick boiler vessel is described. This account covers weldability problems, welding and nondestructive testing equipment, tolerances for the lining-up and bringing together of parts, and mechanical test results.

30078 (CEA-CONF-3157) HYDROSTATIC EXTRUSION. Decours, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Technologie). 3 Jun 1975. 40p. (In French). INIS.

From summer school on metals and alloys working; Villars-sur-Ollon, Switzerland (8 Sep 1975).

Hydrostatic extrusion is a drawing method in which a metal billet is forced through a draw-plate by means of a fluid under

pressure. This process has the great advantage that friction of the billet on the machinery is completely eliminated, but a number of problems arise when it comes to building an industrial apparatus. One is the tightness problem since the equipment must be able to withstand high pressures, a factor which limits the use of the process. At present the method is chiefly used cold under high pressures: 15 to 20 kb. Some attempts are being made to apply it warm or even hot. Various procedures are described in the attached text. Several firms such as Kobe-Steel, A.S.E.A. and Fielding and Platt have designed presses intended exclusively for hydrostatic extrusion. Hydrostatic extrusion has also been carried out hot at the French CEA by adaptation of a system onto a conventional vertical press. (FR)

30079 (COO-2172-6) ALLOY DESIGN THROUGH MECHANICAL EQUATION OF STATE. Li, C. Y.; Ellis, F. V.; Huang, F. H. (Cornell Univ., Ithaca, N. Y. (USA). Dept. of Materials Science and Engineering). 1975. 42p. (CONF-7410156-1). Dep. NTIS $4.00.

From symposium on alloy design; Detroit, Michigan, United States of America (USA) (Oct 1974).

The concept of plastic equation of state and the experimental results which are used to support this approach are introduced. It is shown that considerable savings in mechanical testing are possible in using this approach to establish the constitutive relationships for plastic deformation for a material. Advantages in data correlation and data extrapolation are also described. Examples are given to suggest that the constitutive relationships for plastic deformation obtained may be used as a useful basis for correlating the effects of composition and microstructure changes on mechanical properties and therefore serve as a guide for alloy selection. The savings in mechanical testing suggest also that the approach of plastic equation of state may be adopted for evaluating and assessing the mechanical properties of candidate alloys.

30080 (INIS-mf) MULTICOMPONENT SINTERING FOR PRODUCTION OF MICROSTRUCTURES WITH HIGH POROSITY. Aldinger, F.; Petzow, G. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany). Inst. fuer Werkstoffwissenschaften). 1975. 8p. (In German). INIS.

From 4th European symposium for powder metallurgy; Grenoble, France (13 May 1975).

In sintering of multicomponent systems, the reaction enthalpies lead to diffusion gradients of some orders of magnitude larger than those normally considered in the derivation of the sintering equations. If the mutual diffusivities of the two components are strongly different, then homogenizing of diffusion couples results in the formation of hollow particles. The particles grow as the diffusion of the components occurs from the core into the coating material. An additional expansion takes place due to isotropic expansion of the coating layer. The parameters affecting the isotropic growth are discussed taking as example mixed powders coated with a series of different metals. This effect of isotropic expansion with sintering of cold-compacted preforms produces a volume increase up to 300%, resulting in the case of nickel-coated beryllium powders in densities of less than 0.5 g/cm^3. This mechanism produces equiaxed rounded pores and these highly porous microstructures have relatively reasonable mechanical properties.

30081 (IPR-TN-2/74) CONTROL OF TIME AND CURRENT FOR ZIRCALOY WELDING. Marra, J. G.; Pinto, G. G. (Instituto de Pesquisas Radioativas, Belo Horizonte (Brazil). Divisao de Apoio). Mar 1974. 17p. (In Portuguese). INIS.

A description is given of electronic circuits for the control of time and current for Zircaloy welding. The following is included: system relations, circuit description, material lists and current diagrams. Orientation is given for maintenance work.

30082 (UCRL-Trans-10761) EXPLOSIVE COMPACTION OF CERAMIC AND METAL POWDERS AND MIXTURES THEREOF. Pruemmer, R. Translated from Ber. Dtsch. Keram. Ges.; 50: No. 3, 75-81(1973). 26p. (CONF-7210138-1). Dep. NTIS $4.00.

From annual meeting of the German Ceramic Society; Goslar, German, Federal Republic of (F. R. Germany) (4 Oct 1972).

A brief survey of the existing indirect methods of explosive compaction of ceramic and metal powders is given. The direct method and the physical laws underlying it are described. The behavior of porous substances under the influence of shock waves is calculated. Theoretical-empirical laws are found which permit hollow and cylindrical bodies compacted uniformly over the cross section to be obtained. It is essential that the parameters of the explosive are adapted to the properties of the ceramic or metal powder to be compacted. Alumina, zirconia, boron carbide, titanium carbide, tungsten, and steel powders and their mixtures are compacted to densities to greater than 95 percent of the theoretical value. Possibilities of obtaining geometrically shaped bodies by explosive powder metallurgy are also shown. 13 figures, 18 references (auth)

30083 PERFECTION OF FORGING OF HEAT RESISTING STEEL CASTINGS. Okhrimenko, Ya. M.; Tyurin, V. A.; Akimov, V. V.; Lyakhov, V. V. (Moskovskij Inst. Stali i Splavov (USSR)). Izv. Vyssh. Uchebn. Zaved., Chern. Metall.; No. 11, 83-85(1974). (In Russian)

For English translation see the journal Stal USSR.

30084 WELDING AND FABRICATION OF NON-FERROUS METALS. Volume I. Proceedings of a Conference Held in Eastbourne, England, 2-3 May 1972. Cambridge, Eng.; The Welding Institute (1972). 130p. (CONF-7205117-P1).

From international conference on the welding and fabrication of non-ferrous metals; Eastbourne, UK (2 May 1972).

Twenty-two papers presented at the conference on Al and its alloys, Cu and its alloys, solid state joining, aerospace alloys, and corrosion resistant alloys are included. A separate abstract was prepared for each of three papers selected for NSA. (JRD)

For abstracts of individual papers see: 30085, 30086, and 30138.

30085 SOME FATIGUE PROPERTIES OF WELDED HIGH TEMPERATURE ALLOYS. Dinsdale, W. O. (Welding Inst., Cambridge, Eng.). pp 83-88 of Welding and Fabrication of Non-ferrous Metals. Volume I. Cambridge, Eng.; The Welding Institute (1972).

From international conference on the welding and fabrication of non-ferrous metals; Eastbourne, UK (2 May 1972). See CONF-7205117-P1.

Results of an investigation into the fatigue properties of two high temperature alloys, Nimonic PK33 and C.263, in sheet form are presented. Each alloy has been welded by various welding processes which include TIG, TIG with filler, resistance spot welding, and electron-beam welding. The tests were carried out at room temperature and over the range 700 to 900°C. In the case of the Nimonic PK33 the properties of the welded joints are compared directly with those of plain sheet, but as there was no requirement for plain sheet tests on C.263 it was only possible to compare the results with those for the equivalent welds in Nimonic PK33. It is shown that, regardless of welding process, both materials show an improvement in strength over the room temperature values at approximately 700 to 750°C. It is concluded that the high temperature fatigue strengths of TIG welds (with and without filler additions) in Nimonic PK33 are virtually the same as those of the plain sheet. It is shown that the strengths of electron-beam welds in C.263 are lower than those for Nimonic PK33, though under some conditions the differences are minor. It is also concluded that TIG welds in C.263 compare favorably with Nimonic PK33 at temperatures of up to 800°C. It is finally concluded that there are some apparent anomalies in the results which can only be ascribed to the combined effects of heat treatment, heat of welding, and operating environment. (auth)

30086 FABRICATION AND WELDING OF THE ZIRCONIUM ALLOY CALANDRIA FOR THE TAIWAN NUCLEAR RESEARCH REACTOR. Narduzzi, E. D.; Reynolds, D. E. H. (Dominion Bridge Co. Ltd., Montreal). pp 122-130 of Welding and Fabrication of Non-ferrous Metals. Volume I. Papers. Cambridge, Eng.; The Welding Institute (1972).

From international conference on the welding and fabrication of non-ferrous metals; Eastbourne, UK (2 May 1972). See CONF-7205117-P1.

Fabrication of a nuclear calandria made from Zircaloy-2 is described. The success of the fabrication stemmed largely from sound engineering and prefabrication planning; the development of welding procedures, techniques, and equipment, and the effective translation of these to the shop floor; the training and supervision of the men involved; the full-scale fabrication of a Zircaloy-2 tube sheet for experience before starting the actual calandria; the emphasis on quality assurance and control, and the conscientious adherence to the preconceived assembly procedures and sequences. This resulted in a contract completed ahead of schedule. (auth)

30087 GADOLINIUM PURIFICATION BY REACTIVE DISTILLATION. Evers, J.; Kaldis, E.; Muheim, J.; Zuercher, Ch. (Laboratorium fuer Festkoerperphysik, Zurich). Helv. Phys. Acta; 48: No. 4, 462-464(1975). (In German).

Pure Gd metal was prepared by reactive distillation in vacuum at 10^{-10} torr and 2000°K. Mass spectrographic analysis showed no Y and Pr and only traces of La and Ce. Fe, Co, and Ni appeared as impurities. The content of the non-metallic impurities C, O, F, and H was significantly reduced although 4000 ppM of H still remained in the metal. (JSR)

30088 GROWTH OF SINGLE CRYSTALS OF RARE EARTH METALS AND ALLOYS AT THE EIR. Millhouse, A. H. (Institut

fuer Reaktortechnik ETHZ, Wuerenlingen, Switzerland); Haefeli, R. Helv. Phys. Acta; 48: No. 4, 458-462(1975).

Using solid state annealing techniques it is now possible to produce single crystals of most of the rare earth metals and their alloys sufficiently large for most experimental purposes. The capabilities of these techniques are discussed and examples of their application are presented. (auth)

30089 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON THE WELDING AND FABRICATION OF NON-FERROUS METALS, Volume II. Discussions. Proceedings of a Conference Held in Eastbourne, England, 2–3 May 1972. Cambridge, Eng.; The Welding Institute (1972). 34p. (CONF-7205117-P2).

From international conference on the welding and fabrication of non-ferrous metals; Eastbourne, UK (2 May 1972).

Discussion sessions conducted at the conference on Al and its alloys, Cu and its alloys, solid state joining, corrosion resistant alloys, and refractory alloys are summarized. (JRD)

30090 HOMOGENIZATION OF PLUTONIUM–1.0 wt % GALLIUM ALLOYS. Harvey, M. R.; Robbins, J. L.; Wheeler, A. D. (Univ. of California, Livermore). Micron; 5: No. 4, 417-425 (1975).

The progress of homogenization in Pu-1.0 wt% (3.34 at.%) Ga alloys has been followed with detail heretofore not reported. With selected grains between 50 and 100 μm in diameter, gallium-concentration profiles were determined on as-cast structures and alloys heat treated for 2, 24, and 720 h at 460°C. This was made possible by a microanalysis procedure similar to that used by Ferrera and co-workers and step scanning with the electron beam in this spot mode. It should be noted, however, that while in theory this type of analysis can be applied to almost any system there are many potential problems and much caution must be exercised. (auth)

30091 FABRICATION OF OPTICAL WAVEGUIDES BY ION-BEAM SPUTTERING. Westwood, W.D.; Ingrey, S.J. (Bell-Northern Research, P.O. Box 3511, Station C, Ottawa, Canada, K1Y 4H7). J. Vac. Sci. Technol. 13: No. 1, 104-106 (Jan 1976).

Films have been deposited by sputtering a target with a large-diameter ion beam which can be neutralized by electrons. The ion-beam diameter is defined by a 2-in. (5.08-cm) diam aperture in a Ta plate. Sputtering of this plate acts as a getter pump and substrates are introduced into the system through an airlock so that the residual gas pressure can be maintained in the 10^{-6} Pa range while the sputtering gas ambient is about 6×10^{-3} Pa. Excited species in the vicinity of the target are monitored by emission spectroscopy and the secondary ion mass spectra are measured using an electrostatic energy filter. The performance of the system has been determined by depositing optical waveguides using a Ta target and O and Ar ion beams. With an Ar^+ beam, Ta films with the bcc structure were deposited whereas transparent, amorphous films were obtained using an ion beam containing O and Ar ions. The refractive index of the films was approximately 2.13, which is similar to the value for films reactively sputtered in a glow discharge, and the lowest optical loss was approximately 11 dB/cm. (auth)

30092 CARBOTHERMIC REDUCTION OF REFRACTORY METALS. Anderson, R.N. (Department of Materials Science, San Jose State University, California 95192); Parlee, N.A.D. J. Vac. Sci. Technol. 13: No. 1, 526-529 (Jan 1976).

The reduction of stable refractory metal oxides by carbon is generally unacceptable since the product is usually contaminated with carbides. The carbide formation may be avoided by selecting a solvent metal to dissolve the reactive metal as it is produced and reduce its chemical activity below that required for carbide formation. This approach has been successfully applied to the oxides of Si, Zr, Ti, Al, Mg, and U. In the case where a volatile suboxide, a carbonyl reaction, or a volatile metal occur, the use of the solvent metal appears satisfactory to limit the loss of material at low pressures. In several solute-solvent systems, vacuum evaporation is used to strip the solvent metal from the alloy to give the pure metal. (auth)

30093 DENSITY AND SURFACE TENSION OF MELTS IN THE SYSTEM THORIUM TETRACHLORIDE–POTASSIUM CHLORIDE. Desyatnik, V. N.; Emel'yanov, N. M. J. Appl. Chem. USSR (Engl. Transl.); 48: No. 6, 1434-1436(Jun 1975).

Translated from Zh. Prikl. Khim.; 48: No. 6, 1382-1384(Jun 1975).

The preparation of metallic thorium by electrolysis of thorium tetrachloride–potassium chloride melts was considered with the purpose of possibly using thorium in nuclear reactors. The density and surface tension of melts of $ThCl_4$–KCl systems at 1023°K over a wide range of $ThCl_4$ concentrations were measured by the maximum bubble pressure method. Excess thermodynamic functions were calculated from the density and surface tension data. The dependence of density, surface tension, and excess thermodynamic functions on ThC_4 concentration is presented graphically. (DDA)

30094 HEART PACEMAKER RELIES ON SUPERALLOY. Met. Prog.; 109: No. 2, 8(Feb 1976).

Fabrication of superalloy wires for use in cardiac pacemakers is described. The alloy is composed of 35 Ni, 35 Co, 20 Cr, and 10 Mo combining biocompatibility with improved stress corrosion resistance and fatigue strength. (JRD)

30095 NUCLEAR VALVE MANUFACTURER SELECTS STAINLESS FORGINGS. Met. Prog.; 109: No. 2, 10(Feb 1976).

Forged type 316 stainless steel components for nuclear valves are described. Automatic plasma arc welding with powder filler alloys is employed for hardfacing. Seat ring forgings are surfaced four-at-a-time with Stellite No. 156 in a sequential manner to minimize heat input to the individual components. After cladding and machining, seat rings are welded into the valve body using a semiautomatic, hot-wire gas tungsten-arc process. Disc faces and guide slots are surfaced with Stellite No. 6. The valve stem is machined from 17-4PH forged bar stock in the H-1100 condition. The heat treatment is specified to minimize pitting under prolonged exposure to wet packing. A 12 rms (0.3 mu m) surface finish minimizes tearing of the packing and subsequent leakage. The link and stem pin are SA 564 Grade 660 (in the H-1100 condition) and ASTM A637 Grade 718 respectively. (JRD)

30096 CADMIUM PLATING. Kosmos, J. C. Met. Finish.; 43: 178, 180, 182(1975).

Formulas for the solutions, makeup of bath, and operating conditions are given for cyanide and fluoroborate solutions. Most Cd plating is with the cyanide bath. The fluoroborate bath uses high current density, is stable, has high current efficiency (almost 100 percent), and does not cause H embrittlement. A limitation is poor throwing power. In barrel plating it needs little control. (Metals Abstr.)

30097 INDIUM PLATING. Gray, D. Met. Finish.; 43: 240, 242-243(1975).

Indium electrodeposits may be diffused at low temperature to form surface alloy layers. A cyanide bath with an alkaline hydroxide (such as KOH) as a stabilizer is in general use. If EDTA is used as a stabilizer, KOH can replace cyanide. Other baths of current interest contain sulfate, fluoroborate or sulfamate. Either Pt or In electrodes are used. (Metals Abstr.)

30098 ATOMIC ENERGY AND THE MATERIALS PROBLEM. Ramanna, R. (Bhabha Atomic Research Centre, Bombay (India)). Trans. Indian Inst. Met.; 28: No. 1, 10-17(Feb 1975).

Material problems in connection with nuclear technology have been dealt with in detail. The wide spectrum of activities over the last two decades which has gone a long way in the development of the atomic energy industry has been described. Special materials required for fast reactors and the specifications to be observed stringently in the case of such materials are explained. The use of (1) the VEC in studying the radiation effects on the structural materials, (2) sodium technology in reactors, (3) thorium in fast reactors, etc. are mentioned. The importance of quality control in nuclear industry is stressed. The numerous useful applications of this technology as a healthy feed-back to other industries are touched upon. (KB)

30099 PRODUCTION OF SOME UNCOMMON METALS BY FUSED SALT ELECTROLYSIS TECHNOLOGY. Aravamuthan, V. (Central Electrochemical Research Inst., Karaikudi (India)). Indian Chem. J.; 9: No. 11, 13-23(May 1975).

Fused chloride electrolysis method for the production and purification of uncommon metals like zirconium, hafnium, vanadium, niobium, tantalum, molybdenum, beryllium, uranium, thorium and tungsten is outlined. Different types of electrolytic cells which can be used, their advantages and disadvantages, heat balance, and operational characteristics are also described in brief. (INIS)

30100 THERMAL CONDUCTIVITY OF BOUND SYSTEMS. Dul'nev, G. N.; Eremeev, M. A.; Zarichnyak, Yu. P. (Leningradskij Inst. Tochnoj Mekhaniki i Optiki (USSR)). Inzh.-Fiz. Zh.; 27: No. 1, 55-62(Jul 1974). (In Russian)

For English translation see the journal J. Eng. Phys.

30101 STABILIZATION OF SUSPENSIONS FOR THE ELECTROPHORETIC DEPOSITION OF MIXTURES OF Al, Ge, AND Nb. Avgustinik, A. I.; Alekseev, V. P.; Zhuravlev, G. I.; Okhotnikova, S. I. (Technological Inst., Leningrad). J. Appl. Chem. USSR (Engl. Transl.); 48: No. 4, 953-954(Apr 1975).

Translated from Zh. Prikl. Khim.; 48: No. 4, 907-909(Apr 1975).

By studying the stability, the electrokinetic potential, and the yield of deposit during electrophoresis for suspensions of ternary mixtures of Al, Nb, and Ge, it was possible to establish the op-

timum composition of the dispersion medium: 40 vol % acetone + 60 vol % isobutyl alcohol, with a stabilizer (aluminum hydroxynitrate) concentration of 12 to $16 \cdot 10^{-4}$ M. (auth)

30102 ELECTRODEPOSITION OF RHENIUM–RUTHENIUM ALLOY FROM SULFAMIC ACID SOLUTION. Kozlova, V. A.; Belov, S. F.; Ionycheva, N. S.; Shluger, M. A. (Inst. of Fine Chemical Tech., Moscow). J. Appl. Chem. USSR (Engl. Transl.); 48: No. 4, 955-956(Apr 1975).

Translated from Zh. Prikl. Khim.; 48: No. 4, 909-911(Apr 1975).

Rhenium–ruthenium electrolytic alloy can be recommended for decorative coatings in place of noble metals. Because of the high chemical stability and high-temperature strength of both metals, coatings of this alloy can be used to protect artifacts from corrosion in aggressive media (both liquid and gaseous). The optimum conditions for obtaining rhenium–ruthenium alloy are as follows: sulfamic acid HSO_3NH_2 45 to 50 g/liter; ammonium nitrosopentachlorruthenate $(NH_4)[Ru(NO)Cl_5]$ 1 g/liter; ammonium perrhenate NH_4ReO_4 10 to 20 g/liter; temperature 20°C; cathode current density 10 A/dm^2. (auth)

30103 CHEMICALLY VAPOR-DEPOSITED TUNGSTEN, GRAIN-REFINED AND STABILIZED. Bryant, W. A. (Westinghouse Astronuclear Lab., Pittsburgh). J. Less-Common Met.; 45: No. 1, 37-44(Feb 1976).

Efforts to produce chemically vapor-deposited tungsten, having a fine, thermally-stable microstructure, are reviewed. An experimental approach, which involved the reactant thorium acetylacetonate, in addition to hydrogen and WF_6, was used to prepare tungsten having such a microstructure.

30104 CONTRIBUTION TO THE STUDY OF THE ELECTRONIC MECHANISM OF ACTIVATED SINTERING OF TUNGSTEN. Samsonov, G. V.; Yakovlev, V. I. (Inst. for Materials Development, Kiev). Sci. Sintering; 7: No. 3, 231-239(Dec 1975).

Using experimental data and existing technology, the effects of small additions of nickel on tungsten sintering were considered. Most essential explanation gives consideration of tungsten and nickel electronic interactions followed by separation of free energy and SWASC d^5 of tungsten and d^5 and d^{10} of nickel increase. Owing to the higher energetic stability of tungsten atom, prevailing transition of nickel atom electrons into tungsten atoms occurs leading to unipolar diffusion of tungsten atoms into nickel. SWASC d^5 of tungsten being high, relatively low content of nickel is necessary, corresponding to the quantity required for the formation of monolayer of its atoms on the surface of tungsten particles. At some "critical" content of nickel, electron exchange takes place without further localization. Increase of additive content over "critical" effects saturation of composition by unlocalized electrons, decreases thermodynamical stability of tungsten lattice, and increases mobility of its atoms. These changes condition increase of plasticity of said systems that was observed experimentally.

30105 DISPERSION STRENGTHENED TITANIUM AND ZIRCONIUM ALLOYS. Cairns, R. L.; Benjamin, J. S. (to International Nickel Co. of Canada, Ltd., Copper Cliff, Ontario). Canadian Patent 940,340. 22 Jan 1974. 17p.

Available from Commissioner of Patents, Ottawa.

A wrought composite titaniferous and/or zirconiferous metal powder is provided comprised of a plurality of constituents, the composite powder being advantageously in the heavily cold worked condition and in which particles thereof are characterized metallographically by an internal structure comprised of the starting constituents intimately united together and mutually interdispersed. The process employed in producing the composite metal powder resides in providing a dry charge of attritive elements and a metallic titaniferous and/or zirconiferous powder mass containing at least one non-metallic constituent inert to said metallic powder, subjecting the charge to high energy agitation milling under conditions inert to titanium and zirconium, preferably above room temperature, in which the charge is maintained kinetically in a highly activated state of relative motion, and continuing the milling under controlled inert conditions to produce wrought composite metal powder in which particles thereof are characterized metallographically by an internal structure in which the metallic and non-metallic constituents are substantially mutually interdispersed. (Patent Office Record)

30106 PREPARATION OF HIGH PURITY INDIUM. Rao, G. S.; Phatak, G. M.; Gangadharan, K. (Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.). Indian J. Technol.; 12: No. 6, 256-259(Jun 1974).

Data are presented on the purification of indium by multistage electrorefining of commercial indium in sulfate bath using cotton bagged indium anodes and pure indium cathodes. The optimum conditions established are: concentration of indium, 50 to 55 g/l; supporting electrolyte (sodium chloride), 80-100 g/l; additive (glue), 1g/l, pH of the bath, 2 to 2.5; and cathode current density, 1 A/sp dm. The overall current efficiency was found to be >95%. Indium of 99.999% purity has been obtained by four-stage electrolytic refining. Data on the removal of thallium from indium by various methods are also presented. (auth)

30107 METHOD OF MAKING A COATED STEEL PLATE. Yoshida, K.; Hamamura, T.; Kanamaru, T. (to Nippon Steel Corp., Tokyo). Japanese Patent 19,748,929/B/. 6 Aug 1969. 6p. (In Japanese)

A method of applying a protective coating to a layer of an electron sensitive primer coated onto a surface treated steel plate is given, using a composition that can be hardened by irradiation with electron beams. In one embodiment, an acrylic coating is applied as a primer 5μ thick to a steel plate, and then baked at 500°C for 4 to 8 seconds. When the primer is lightly baked and is hardened by irradiation together with the superimposed layer, the coatings show superior adhesiveness and bending strength. The superimposed layer has a composition which comprises, for example, a polymer having a double bond and/or epoxy radical, and a monomer having a double bond such as styrene and acrylic acid. The thickness of the superimposed layer may preferably be 5 to 50μ for adhesive and corrosive properties. The energy level of electron beams may be 100 to 500 KeV. The radiation doses may be 0.1 to 10, preferably 0.5 to 5 Mrad.

30108 STATUS OF NON-DESTRUCTIVE INSPECTION TECHNIQUES WITH SPECIAL REFERENCES TO WELDING DEFECTS. Packman, P. F. (Vanderbilt Univ., Nashville, Tenn. (USA)). pp 9-21 of Significance of Defects in Welded Structures. Kanazawa, T. (Tokyo Univ. (Japan). Faculty of Engineering); Kobayashi, A. S. (eds.). Tokyo, Japan; University of Tokyo Press (1974).

From Japan-U.S. seminar on significance of defects in welded structures; Tokyo, Japan (15 Oct 1973).

The state-of-art in non-destructive inspection techniques (NDT) with reference to weld-defect detection and size discrimination is reviewed, and minimum flaw detection capability and flaw criticality measurement by the NDT are summarized. The use of fracture mechanics as a design analysis technique has altered the nature of research and development process of NDT. The NDT process must be optimized so that definite indication of a flaw may be given. The reliability of flaw detection capability for small flaw size is improved in this way. Additional techniques are then used to determine the criticality such as size and shape. The quantitative aspects of NDT are yet in rudimentary stage.

30109 WIRE FEEDER AND POSITIONER FOR NARROW GROOVE ELECTRON BEAM WELDING. Murphy, J. L.; Turner, P. W. (Union Carbide Corp., Oak Ridge, TN). Weld. J. (N. Y.); 55: No. 3, 181-190(Mar 1976).

The design criteria, wire feeder operation, and performance of automated electron beam welding apparatus are described. Information and discussions are included on wire feeder positioners, programming equipment, and computer control. Evaluations of the wire feeder in welding Al alloys, steels, and U are given. (JRD)

30110 SUPERPLASTIC FORMING OF Ti–6Al–4V BEAM FRAMES. Hamilton, C. H.; Stacher, G. W. (Rockwell International Corp., Los Angeles). Met. Prog.; 109: No. 3, 34-37 (Mar 1976).

Applications based on the plastic properties of Ti–6Al–4V are described. Superplastic forming of this alloy is discussed and its uses in the B-1 bomber nacelle fittings, intake duct, and nacelle center beam frame are examined. (JRD)

Properties, Structure, and Phase Studies

Refer also to abstracts 28758, 28759, 28772, 28987, 29979, 30368, 31127, 31620, 31623, 31628, 31629, 31811, 32509, 32513, 32514, and 32538.

30111 (AD/A-005358) STATIC AND DYNAMIC INTERPRETATION OF TITANIUM ALLOY PHOTOMICROGRAPH FEATURES. Technical Report, 15 Feb 1973-15 Feb 1974. Dreher, J. J. Nov 1974. Contract F33615-73-C-5108. 75p. NTIS $4.25.

Computer and hand generated geometrical data from Ti-6Al-2Sn-4Zr-6Mo photomicrographs were statistically treated to establish family groupings of certain physical properties. These families, established by duration and free-path distribution functions, define various statistically different packets of mechanical properties which correlate to various degrees with other measured geometries. Following an Air Force Materials Laboratory (AFML) specification of an acceptable mechanical property profile, ten qualifying samples were additionally subjected to analyses sensitive to particle mass and spatial placement. Two novel

methods, autocorrelation of particle mass equivalents and a stroboscopic pattern detection technique, indicated the interrelations of spatial distribution patterns and the properties of ductility, fatigue resistance, toughness, and crack propagation. (GRA)

30112 (AD/A-005722) EFFECT OF A THIN DIFFUSED SOLUTE LAYER ON THE NUCLEATION OF FATIGUE CRACKS. Final Report. Greenfield, I. G.; Swain, M.; Snyder, D. M. (Delaware Univ., Newark (USA). Coll. of Engineering). Jan 1975. 23p. NTIS $3.25.

See also report dated Dec 1972, AD-755385.

Methods of controlling the nucleation and growth of fatigue cracks in Ti-6Al-4V alloy were investigated. The technique employed was based on the development of a thin diffused concentration profile of a second element in the surface layers of the specimen. If the deformation characteristics of the thin layer lead to the delay of the development of the start of fatigue cracks, then the lifetime of the alloy can be increased. Moreover, since environmental conditions affect fatigue, the chemical nature of the surface layers might impede crack growth once it is started. The results of the experiments conducted show that specific concentration profiles of solutes improve the fatigue life of the alloy. Most interesting was the fact that dissolved oxygen in a thin layer at the surface is beneficial to the fatigue life of titanium alloy. (GRA)

30113 (AD/A-005967) WORK FUNCTION OF THE (100) FACES OF SINGLE CRYSTALS OF REFRACTORY METAL ALLOYS. Smirnova, N. B.; Smirnov, B. G.; Sytaya, E. P. Translated from Nauchn. Tr., Tashkent. Gos. Univ.; No. 393, 230-235 (1971). 8p. (FSTC-HT-23-935-74). NTIS $3.25.

Results of measurement of the work functions of the (100) faces of two tungsten-base alloys and one tantalum-base alloy are presented. The crystals studied, of W–5Re, W–1Ta, and Ta–20Mo, were grown by zone equalization and had spontaneous (100) orientation. The work functions of the W–5Re and Ta–20Mo alloys were close to (100) of pure W and Mo, and they were considerably below the work functions of the (100) faces in W and Ta for W–1Ta alloy. (GRA)

30114 (AD/A-005979) WORK FUNCTION AND ADSORPTION PROPERTIES OF YTTRIUM GROUP RARE EARTH METALS. Kultashev, O. K.; Rozhkov, S. E. 1 Nov 1974. Unedited translation of Redkozemelnye Metally i ikh Soedineniya (sic), v70, p66-76, Naukova Dumka, Kiev, USSR, 1970. (FSTC-HT-23-177-75). 15p. NTIS $3.25.

Experimental methods are described for determination of the work functions of REM as the metals and in thin films and for determination of the heat of adsorption. The work functions in thin films decrease over time and then rise to a constant value. The heats of adsorption of Gd, Ho, and Er decrease with increase in atomic number but that of lutetium is highest of all, and appears to be independent of the substrate. The differences in work functions of thulium and lutetium appear to be connected with the fact that the f shell of the latter is completely filled and the f shell of the former is generally empty. The change in heat of adsorption apparently involves weakening of the metallic bonds of the adsorbed atoms and formation of ionic bonds between the adatoms and the substrate atoms. (GRA)

30115 (AD/A-007209) AN EXPERIMENTAL INVESTIGATION OF DYNAMIC MATERIAL PROPERTIES. Final Report, 1 Sep 1964-30 Nov 1973. Lindholm, U. S.; Davidson, D. L. (Southwest Research Inst., San Antonio, Tex. (USA). Dept. of Materials Sciences). Jan 1975. 18p. NTIS $3.25.

Work performed over a 12-year period concerned with the mechanical properties of materials deformed under high strain rates or impact conditions is summarized. The work included the development of uniaxial and biaxial testing equipment for dynamic plastic deformation studies, the use of this equipment for generating stress-strain-strain rate relations for a number of metals and alloys over a wide temperature range, and the correlation of this data in the form of appropriate constitutive equations. A list of publications resulting from this work is included. (GRA)

30116 (AD/A-007427) FRACTOGRAPHY OBSERVATIONS OF FATIGUE FAILURES IN TITANIUM ALLOYS. Research Memo. Tobin, A. (Grumman Aerospace Corp., Bethpage, N.Y. (USA). Research Dept.). Feb 1975. 18p. (RM-594). NTIS $3.25.

Fractographic examinations were made on two titanium alloys Ti–6Al–4V and Ti–6Al–2Sn–6V; the alloys were subjected to different thermomechanical histories and failed in a constant amplitude fatigue test. Results showed no specific correlation between chemistry of alloy and failure mode; however, a clear-cut microstructural dependence of local crack advance was noted. Alpha grain boundaries and alpha-beta interfaces were delineated by the presence of secondary cracks showing their relative weakness. The fracture appearance of these alloys is explained in terms of the localized cyclically work-hardened zone just ahead of the advancing fatigue crack. (GRA)

30117 (AD/A-009163) ACOUSTIC CHARACTERISTICS OF TWINNING IN INDIUM. Interim Report. Van Doren, S. L.; Pond, R. B. S.; Green, R. E. Jr. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Mechanics and Materials Science). Nov 1974. Contract F44620-71-C-0062. 71p. NTIS $4.25.

Since mechanical twinning is one of the major causes of fatigue failure in metals, acoustic emission measurements were made during mechanical deformation of indium single crystals. Indium was selected since upon stress application well delineated twins develop which can be made to disappear upon stress reversal. Associated with this twinning and detwinning are high intensity acoustic emissions and therefore indium affords an excellent material with which to develop techniques. By recording the acoustic emission signals on a video tape recorder it was possible to play them back as often as desired, to observe them in slow and stop motion, and to play any desired portion of the signal through a spectrum analyzer for frequency analysis. The experimental results show that a correspondence exists between the duration of the acoustic signal and the volume of twinned material as determined by cinematographic observation of the generation and growth of twin bands. (GRA)

30118 (AD/A-009350) SUPERCONDUCTING COMPOUNDS OF METALS AND THEIR USES. Savitskii, E. M.; Efimov, Yu. V. 12 Apr 1974. Translation of monograph Metallovedenie, n.p., 1971, p408-414. (FSTC-HT-23-127-74). 16p. NTIS $3.25.

Semiempirical and empirical relationships between the physicochemical parameters of the class of metal compounds, otherwise referred to as "intermetallides," and their superconducting transition temperatures are analyzed. Relationships are sought between degree of metallic bonding in their lattices, crystal structure types, and phase changes, and their superconducting transition temperatures. (GRA)

30119 (AD/A-009789) FATIGUE RESISTANCE CRITERIA FOR FIBER-REINFORCED COMPOSITE STRUCTURES. Final Report, 1 Apr 1971-30 Sep 1974. Dvorak, G. J. (Duke Univ., Durham, N.C. (USA). Dept. of Civil Engineering). Oct 1974. 14p. NTIS $3.25.

The research effort was concentrated on metal matrix composites, such as the Al–B, Al–Be, Cu–W, and similar systems. It was found that in as-fabricated composites with soft matrices fatigue failure can be prevented if the composite shakes down during cyclic loading. The fatigue strength of heat-treated composites is affected by residual microstresses, but failure can be prevented if the total microstresses are kept within the respective fatigue limits (at 10 to the 7th power cycles) of the constituents. These criteria for prevention of fatigue failure in metal matrix composite systems were verified by extensive comparisons of theoretical predictions with available experimental results. (GRA)

30120 (AD/A-009892) DEFORMATION BEHAVIOR IN QUENCHED AND AGED BETA TITANIUM ALLOYS. Technical Report. Paris, H. G.; LeFevre, B. G.; Starke, E. A. Jr. (Georgia Inst. of Tech., Atlanta (USA). School of Chemical Engineering). 28 Apr 1975. Contract N00014-75-C-0349. 22p. NTIS $3.25.

The deformation characteristics of quenched and aged Ti-V alloys in the composition range 20 to 40 percent V have been examined by optical metallography and transmission electron microscopy. A coarse lenticular deformation product similar in appearance to previously reported strain induced "martensites" was found to be associated with the occurrence of the omega phase. These features proved to be (112) [111] twins. Continued aging of the omega containing alloys resulted in a transition of the deformation mode from twinning to slip at a point which corresponded to the onset of embrittlement or alpha precipitation at the omega-beta interfaces. The formation of deformation twins in a two-phase omega-beta structure is discussed in terms of possible mechanisms. (GRA)

30121 (COO-3150-38) SOLID STATE PHYSICS: MAGNETIC PHENOMENA. Final Report, 1961–1975. Bowers, R.; Silsbee, R. H. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Jan 1976. 27p. Dep. NTIS $4.00.

Research activities centered at Cornell University in: (1) electron spin resonance and (2) the electronic transport properties of metals are described. A list of 150 publications and technical reports published by this group since 1958 is included. (GHT)

30122 (CTOM-16921) THERMALLY ACTIVATED DEFORMATION IN NIOBIUM-ZIRCONIUM SOLID SOLUTIONS. Tiwari, S. N. (Manitoba Univ., Winnipeg (Canada). Dept. of Mechanical Engineering). 1973. 172p. INIS.

Microfiche only.

The deformation behavior of zone refined polycrystalline niobium solid solutions containing up to 4.7 at % Zr was studied between 77°K and 490°K. Strain rate change and stress relaxation techniques were used to determine the activation parameters of deformation, the dislocation velocity stress exponent, and the thermal and athermal components of the flow stress as a function of strain, temperature and concentration. At room temperature the flow stress increased linearly with concentration although its components did not. Solution softening was observed at 77°K and the softening temperature range decreased with increasing Zr content. The softening effect was due to a decrease in the thermal component of flow stress on alloying. The rate of work hardening increased slowly with solute concentration. Dislocation arrangement was dependent on the thermal stress, σ^*. It was found that as σ^* increased the screw dislocation density increased and the amount of tangling decreased. At higher strains dislocation cells were formed and their diameter decreased with increase in σ^*. (INIS)

30123 (INIS-mf) EFFECT OF HOMOGENEOUS AND HETEROGENEOUS POWDER IMPURITIES ON SINTERED TUNGSTEN AND MOLYBDENUM. Lassner, E.; Petter, H.; Tiles, B.; Benesovsky, F. (Metallwerk Plansee A. G., Reutte/Tyrol (Austria)). 1975. 5p. (In German). INIS.

From 4th European symposium for powder metallurgy; Grenoble, France (13 May 1975).

A classification is given of the different impurities found in the raw materials for the powder metallurgical production of tungsten and molybdenum and their effect on the final product is shown by means of examples. Heterogeneous impurities cause intense local variation of properties (material defects), whereas the homogeneous impurities may have different effects; when present in solution (interstitial or at lattice sites), the effect is slight; in the form of precipitates they may cause important modifications of properties.

30124 (INIS-mf-1875) DISPERSION OF PHONON WAVES IN YTTRIUM. Cavalheiro, R.; Shukla, M. M. (Universidade Estadual de Campinas (Brazil). Instituto de Fisica). 1973. 9p. INIS.

Phonon dispersion curves of yttrium along the two principal symmetry directions, i.e., 0001 and 0110, are calculated on the basis of a model proposed for hcp metals. The calculated results are found to be in close agreement with the experimental ones. (INIS)

30125 (INIS-mf-1876) LATTICE DYNAMICS OF NOBLE METALS ON MODIFIED BHATIA'S MODEL. Bertolo, L. A.; Shukla, M. M. (Universidade Estadual de Campinas (Brazil). Instituto de Fisica). 1974. 13p. INIS.

Phonon spectra and lattice heat capacities of copper, silver and gold have been calculated on the basis of modified Bhatia's model. Calculated phonon dispersion curves as well as (O-T) curves of copper, silver and gold are found to give reasonable agreements with the experimental data. (INIS)

30126 (INIS-mf-1924) STUDY OF THE HYPERFINE MAGNETIC FIELD ON MOLYBDENUM IN IRON, AS A FUNCTION OF TEMPERATURE. Brandao, D. E. (Rio Grand do Sul Univ., Porto Alegre (Brazil). Instituto de Fisica). 1971. 112p. (In Portuguese). INIS.

The experimental investigation of the hyperfine magnetic field on ^{95}Mo in Fe, as a function of temperature, by the gamma-gamma perturbed angular correlation method is presented. The equipment used basically consists of a coincidence system which includes a multichannel analyzer and two detectors, with data collection and magnetic field inversion automatically performed. One verifies that the hyperfine magnetic field curve as a function of temperature does not follow the spontaneous magnetization curve of iron. The interpretation of the experimental results is performed in terms of the molecular field model, molecular field model with conduction electron polarization, and transition model.

30127 (INIS-mf-1971) COBALT-CONTAINING HIGH-STRENGTH STEELS. A Critical Review of the Physical Metallurgy of Cobalt-Containing High-Strength Steels, and a Survey of Their Processing, Properties and Uses. Magnee, A.; Drapier, J. M.; Coutsouradis, D.; Habrakan, L.; Dumont, J. (Centre de Recherches Metallurgiques, Liege (Belgium)). 1974. 128p. INIS.

Cobalt has been shown to play an important role in the three families of high-strength steels reviewed in the present volume, viz. carbide-strengthened, Ni-Co-Mo maraging, and stainless maraging. Very briefly, in addition to exerting a small solid-solution hardening effect, cobalt increases the M_s temperature; this factor has been used to advantage in counteracting the depressing effect of the other alloying elements present in these steels. Cobalt also refines the martensitic structure and leads to retention of the dislocation substructure at higher tempering temperatures, thereby giving rise to a finer precipitation of dislocation-nucleated carbides or intermetallic compounds. Finally, cobalt may affect the precipitation reactions themselves, e.g. by decreasing the solubility of molybdenum and chromium, and may induce ordering in the matrix. As a result of these effects, particularly the obtention of a fine dispersion of the strengthening phases, the steels under consideration exhibit attractive combinations of strength and toughness.

30128 (ITP-75-58R) CLASS OF PSEUDOPOTENTIALS CONSTRUCTED ON THE BASIS OF COMPLETELY ORTHOGONALIZED PLANE WAVES. Gurskii, B. A.; Gurskii, Z. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 28p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The orthogonalized plane wave basis used in the theory of pseudopotentials, is overcomplete and nonorthonormal. In this paper a detailed analysis of the C.O. P.W. basis (completely orthogonalized plane waves) free from these defects, is done. The pseudopotential Wcopw is obtained by means of the COPW formalism. In a special case we obtain as various approximations the formerly known pseudopotentials. The relations between two classes of pseudopotentials, Wcopw and Wopw are discussed. (auth)

30129 (JAERI-1237) LOW CYCLE FATIGUE STRENGTH OF SOME AUSTENITIC STAINLESS STEELS AT ROOM TEMPERATURE AND ELEVATED TEMPERATURE. Shibata, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1975. 28p. (In Japanese). Dep. NTIS (US Sales Only) $5.00.

Low cycle fatigue phenomenon at high temperature on the structural components of fast breeder reactor which consists of some austenitic stainless steels is one of the most important problems concerning with the design and construction of the reactor. Fatigue tests were conducted for the purpose of obtaining the basic data on stainless steels by means of a bend testing. Type 304, 316, and 316L stainless steels have been tested from room temperature to 650°C using two kinds of test specimens. Type 304 stainless steel was tested under several cyclic rates at 550 and 650°C, to determine the effects of cyclic rate on its fatigue strength. Test results are summarized as follows: the bending and axial fatigue strength measurements at room temperature agree, Manson-Coffin's fatigue equation can be applied to the results, the ratio of crack initiation to failure life become larger at higher stress level, and the relation between crack propagation life and total strain range or elastic strain range are linear in log-log scale. This relation also agrees with the equations which were derived from some crack propagation laws. It is also observed at the elevated temperature test, that the reduction of fatigue strength is not noticeable below 500°C, but it is noted at higher temperature, the cyclic rate does not affect fatigue strength in faster cyclic rate than 20 cpm and below 100,000 cycles life range, and type 316 stainless steel shows better fatigue resistance than does types 304 and 316L stainless steels. (auth)

30130 (KFK-2180) COMPARATIVE SERVICE LIFE UNDER CREEP AND CREEP TESTS ON THREE TITANIUM-STABILIZED 15/15 CrNi STEELS WITH VARIOUS CONTENTS OF W-Mn-Mo AND BORON. Schirra, M.; Seith, B.; Solano, R. R.; Rivas, M. de las. (Kernforschungszentrum Karlsruhe (F.R. Germany). Projekt Schneller Brueter; Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung; Junta de Energia Nuclear, Madrid (Spain)). Jul 1975. 19p. (In German). INIS.

28 figs.; 3 tabs.; 14 refs. With app.

Three titanium stabilized 15/15 CrNi steels were tested for their behavior under reactor operating conditions in the temperature region of 650 to 750°C. They essentially differed in the matrix hardening elements (Mn, Mo, W) and in the boron content. Each steel was investigated in two thermo/mechanical treated states: state I = 1150°C 30 min/water + 800 23 h/air + 10% cold-pressed; state II = 1150°C 30 min/water + 10% cold-pressed. There is no essential difference in the three steels in pre-treatment state I regarding time-dependent creep. Also the absolute values as well as the voltage dependence of the secondary creep rate show no great variation. The Ti-stabilized steel is clearly superior to the other two if the time-yield strength ratio and the ductility values are considered.

30131 (ORNL/TM-5245) LOW-STRAIN TENSILE BEHAVIOR OF TYPE 304 STAINLESS STEEL (HEAT 9T2796). Swindeman, R. W. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 26p. AT.

Low-strain tensile data are presented for a reference heat of type 304 stainless steel (heat 9T2796) over the range 25 to

760°C and for strain rates extending from 1.5×10^{-6} to 8.3×10^{-2}/s. A model, based on the Ludwik equation, is developed to represent the tensile yield curve to 5 percent strain at temperatures where creep is not significant. The model is used to develop a set of standard curves for use in inelastic analysis. 19 figs (auth)

30132 (TT-72-58001) DIFFUSION PROCESSES IN METALS. Translated from Metallofizika; No. 28, vp. (1969). 133p. (DMDC-15691; DMDC-15701). NTIS $5.75.

See also TT-72-55075. Also includes rept. Nos. DMDC-15692 thru DMDC-15700. Sponsored in part by National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.

This book consists of a collection of papers dealing with diffusion welding of metals, effect of irradiation on diffusion and diffusion-controlled processes, migration of particles in the stress-field of dislocation loops, diffusion in liquid metals, grain boundary diffusion, nitriding of Armco iron and steel, austenite decomposition, effects of the Curie temperature on diffusion processes in iron-carbon alloys, grain growth in pure nickel, effect of pressure on the self-diffusion of cobalt in Ti-Co alloys, and the kinetics of graphitization in cast iron. (GRA)

30133 (TT-74-58011) DIFFUSION COEFFICIENTS IN MOLTEN METALS. Kononenko, V. I.; Yatsenko, S. P. Translated from Tr. Inst. Khim., Akad. Nauk SSSR, Ural. Fil.; 23: 62-67(1971). 10p. (DMDC-14094). NTIS $3.25.

The self-diffusion coefficients of indium and tin were determined experimentally in not only the pure metals but a wide range of binary liquid indium-tin alloys over the temperature range 800 to 1100°K. Activation energies and pre-exponential factors were calculated for each metal. A break in the Arrhenius plot was found. Coefficients of diffusion for Ag, In, Th, Sn, Pb, Sb, and Bi in liquid gallium were calculated from viscosity data. (GRA)

30134 (TT-74-58023) METALLIZATION ON CUBIC BORON NITRIDE. Naidich, Yu. V.; Vishrevskii, A. S.; Kolesnichendi, G. A.; Chistyakov, E. M.; Yakunova, E. D. 1974. Translation of Smaivemost i Poverkhnostne Svoistva Rasplavov i Tverdyh Tel (USSR), v12, p 179-181, Akademiya Nauk, Kiev, USSR, 1972. (DMDC-14736). 7p. NTIS $3.25.

Sponsored in part by the National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.

Cubic boron nitride was immersed in molten alloys of Cu-Ti, Ag-Ti, Cu-Ag-Ti and Cu-Sn-Ti after which the specimens were examined in an electron microprobe analyzer for penetration of Cu and Ti. Metallographic examination was employed in the study of phases formed during immersion. (GRA)

30135 THE CRYSTAL STRUCTURE OF THE COMPOUNDS $V_{11}Ge_8$, $Cr_{11}Ge_8$, AND $Mn_{11}Ge_8$. Israiloff, P.; Voellenkle, H.; Wittmann, A. (Technische Hochschule, Vienna (Austria). Inst. fuer Mineralogie, Kristallographie und Strukturchemie). Monatsh. Chem.; 105: No. 6, 1387-1404(Nov 1974). (In German)

The crystal structure of the isotypic compounds $T_{11}Ge_8$ (T = V, Cr,Mn) was determined by means of direct methods from Weissenberg data of a $Cr_{11}Ge_8$ single crystal. A final R-value of 7.7% was obtained by least squares refinement based on 684 observed reflexions. The orthorhombic unit cell (Pnam-D_{2h}^{16}) with the dimensions a = 13.171, b = 15.775 and c = 4.939 Å contains 4 formula units $Cr_{11}Ge_8$. Atoms are arranged mainly in primary layers at Z = ¼, ¾ with nets comprising squares, pentagons, and hexagons, which are all centered by atoms of secondary layers at Z ≈ 0, ½. Secondary layer atoms form T-T-chains as well as Ge-Ge-chains in z-direction with short bond lengths (2.47 Å). The structural relationship between $Cr_{11}Ge_8$, Cr_5Ge_3(W_5Si_3-type), and V_6Si_5 is discussed. (auth)

30136 INFLUENCE OF CRYSTAL GROWTH KINETICS ON THE SUBSTRUCTURE OF MOLYBDENUM SINGLE CRYSTALS. Gartman, M. V.; Glebovskij, V. G.; Kopetskij, Ch. V.; Shmyt'ko, I. M. Fiz. Khim. Obrab. Mater.; No. 5, 50-52(1974). (In Russian)

A dependence of the nature of the substructure of 8-mm-dia Mo monocrystals grown by electron-beam crucible-free zone melting on the rate of growth was demonstrated. At a low growth rate (0.5 mm/min) a strongly polygonal structure was observed, but at high rates (up to 6 mm/min), polygonal boundaries were absent and the substructure showed individual corrosion pits. A radial heterogeneity of structure that was observed is due to movement of the dislocations in a field of axial and radial temperature gradients of the growing crystal. (tr-auth)

30137 LIQUID-ALLOY THEORY BASED ON THE CONCEPT OF SPHERICAL GROUPING. Filippov, E. S. (Moskovskij Inst. Stali i Splavov (USSR)). Izv. Vyssh. Uchebn. Zaved., Chern. Metall.; No. 11, 126-131(1974). (In Russian)

For English translation see the journal Stal USSR.

An earlier developed theory of liquid metals was applied to liquid alloys. The liquid metal or alloy is represented as a mixture of spherically arranged grouping with ideal packing of atoms and limited loose packing. In liquid alloys individual points (starting with 0.5 at. %) of sharply changing volume are found at C_1, C_2, C_3, and C_4, where C_4 coincides with the limiting solubility in the solid phase or with concentrations of ordering of the type A_3B (B_3A). The relationships obtained are stated. At C_1, C_2, C_3, and C_4 there is a 2.85-fold reduction in the spherical grouping. At $C_4 = C_p$ (where C_p is the limiting solubility) the grouping is completely changed to individual atoms. An increase over C_p leads to the appearance of other groupings based on the second component, B. Depletion of the solution in component B leads also to formation again of groupings of solvent A. Therefore over a eutectic horizontal there should be expected an area of a mixture of spherical groupings of A and B. From 0% to C_1 the additive is distributed between the spheres, and from C_1 to C_2 it is in the spheres. At C_2 a granulation of the grouping (2.85-fold) starts, and the additive transfers from the spheres to a loose packing. (tr-auth)

30138 PHENOMENON OF SUPERPLASTICITY OF POLYMORPHOUS METALS AND ALLOYS AND ITS USE FOR WELDING AND HARDENING IN THE SOLID STATE. Rykalin, N. N.; Shorshorov, M. Kh.; Antipov, V. I.; Nadirashvili, N. I.; Tikhonov, A. S. (Inst. of Metallurgy, Moscow). pp 89-94 of Welding and Fabrication of Non-ferrous Metals. Volume I. Cambridge, Eng.; The Welding Institute (1972).

From international conference on the welding and fabrication of nonferrous metals; Eastbourne, UK (2 May 1972). See CONF-7205117-P1.

Special publications have recently contained many articles on the phenomenon of superplasticity in different types of metallic substances: pure metals, multiphase alloys, and powdered metal substances. In most cases study of the phenomenon of increased ductility has followed two main lines, some of the work concerning investigation of the mechanisms at the basis of this most interesting phenomenon, the principal purpose of the remainder being to find methods of putting it to practical use. In the work described, the possibility of utilizing this effect in processes by which metallic substances are joined in the solid state was investigated. (auth)

30139 ELECTRONS AT METAL SURFACES. Lundqvist, S. (Chalmers Univ. of Tech., Goteborg). pp 331-392 of Surface Science. Volume I. Vienna; International Atomic Energy Agency (1975).

From international meeting on surface science; Trieste, Italy (16 Jan 1974). See STI/PUB-396(Vol. 1); CONF-740139-P1.

Concepts, ideas, and methods are introduced and some of the basic physics discussed. After a description of theory based on the Sommerfeld model, the band structure approach to electrons at metal surfaces is discussed. Theory for calculation of surface properties is presented. Response of metal surface to perturbations (screening) is dealt with. Surface plasmon oscillations are discussed. Among the metals discussed is tungsten. 56 references, 29 figures (DLC)

30140 ATOMIC SCATTERING. Nahr, H. (Univ., Erlangen, Ger.). pp 9-62 of Surface Science. Volume II. Vienna; International Atomic Energy Agency (1975).

From international meeting on surface science; Trieste, Italy (16 Jan 1974). See STI/PUB-396(Vol. 2); CONF-740139-P2.

The scattering of atoms with thermal energy is a method for investigating the topmost monolayer of a solid surface. The scattering process is first treated classically and the influence of the properties of both the gas atom and the solid is discussed by use of simple models. Whereas the classical treatment is suitable for inelastic scattering processes with many phonons involved, elastic and few-phonon inelastic scattering processes are covered by the quantum-mechanical scattering theory, which is briefly summarized. Recent experiments are discussed, where alkali halide and metal single crystals are investigated by atomic beam scattering. By using light gas atoms (H, H_2, He) diffraction occurs, and the structure of adsorbed layers, the surface Debye temperature, and the gas-solid interaction potential can be studied. 47 figures, 51 references (auth)

30141 SUPERELASTICITY IN THERMOELASTIC Au–Cd ALLOY. Miura, S. (Doshisha Univ., Kyoto); Mori, T.; Nakanishi, N. pp 141-151 of Mechanical Behavior of Materials. Volume II. Kyoto; Society of Materials Science, Japan (1974).

From symposium on mechanical behavior of materials; Kyoto, Japan (21 Aug 1974). See CONF-740847-P2.

Superelastic behavior in Au-47.5 at.% Cd and Au-49.5 at.% Cd was studied by means of microscopic surface observation, analysis of Laue photograph, and measurement of the strain distribution.

The superelasticity above the transformation temperature (To) in Au–47.5 at.% alloy is associated with the transformation, β (bcc) → β' (orthorhombic) upon loading and β' → β upon unloading and below To, superelasticity in quenched and aged martensite is due to the migration of the twin boundary in the martensite crystals. In Au–49.5 at.% Cd alloy, below To, significant superelasticity was only observed when the specimen axis is near the $\langle 100 \rangle_\beta$ pole and this superelasticity was accompanied by the transformation β'' (trigonal) → β' upon loading, β' → β'' upon unloading and above To, observed superelasticity is same as those found in Au–47.5 at.% Cd. In the stress-induced transformation, it was found that upon loading, the band which consists of alternate layers of bcc phase and martensite phase, is formed at one end of the specimen and advances towards the other end, then superelastic strain $\Delta\epsilon_T$ vanished. By the measurement using strain gage, it was found that the difference of amount of strain $\Delta\epsilon_T$ is in between, before, and after the passage of the lamellar region of the band. (auth)

30142 STRESS DEPENDENCE OF CREEP-RATES AND RATE-CONTROLLING MECHANISMS IN HIGH-TEMPERATURE CREEP OF SOLID SOLUTIONS. Oikawa, H.; Karashima, S. (Tohoku Univ., Sendai). pp 169-177 of Mechanical Behavior of Materials. Volume II. Kyoto; Society of Materials Science, Japan (1974).

From symposium on mechanical behavior of materials; Kyoto, Japan (21 Aug 1974). See CONF-740847-P2.

The internal stress, σ_i, and the effective-stress exponent of dislocation velocity, m*, were determined during creep of Fe–3.5 at.% Mo, Al–5.5 at.% Mg, Ni–10.3 at.% W, and Ni–9.5 at.% Cr alloys at about 0.65 T_m. Values of σ_i obtained by stress-transient dip test were small and almost independent of the applied stress, σ_c, in Fe–3.5 Mo alloy. In other three alloys, σ_i increased with increasing σ_c as in the case of many pure metals. The value of m* obtained by analyzing stress-relaxation curves immediately after creep deformation was unity in Fe–3.5 Mo and Al–5.5 Mg alloys. Therefore, these alloys are alloy-type materials, creep of which is controlled by a microcreep mechanism. In Ni–10.3 W and Ni–9.5 Cr alloys, m* is obviously larger than unity. These alloys are considered to be of pure-metal type, creep of which is controlled by a recovery process as in many pure metals. On the other hand, Fe–3.5 Mo, Al–5.5 Mg, and Ni–10.3 W alloys have been classified with class I alloys under the present condition according to the fact that the applied-stress exponent of the steady-state creep rates, n, is about 3. Therefore, neither n-value nor the level of σ_i is not a sufficient factor to identify the creep mechanism. (auth)

30143 ELEVATED TEMPERATURE MECHANICS OF METALS. Manjoine, M. J. (Westinghouse Research Labs., Pittsburgh). pp 193-214 of Mechanical Behavior of Materials. Volume II. Kyoto; Society of Materials Science, Japan (1974).

From symposium on mechanical behavior of materials; Kyoto, Japan (21 Aug 1974). See CONF-740847-P2.

Ductility is the ability of a material to deform and to relax stress peaks without reaching a fracture instability. Damage is the process of exhausting ductility. For metals at elevated temperature the incremental damage can result from principal stress history or strain history. The relative damage is a function of the strain rate and state of stress. To demonstrate the influence of these factors on the limiting strain at a fracture instability, the data for a 12 Cr 3 W steel and Refractaloy 26 at 1200F, representing different levels of ductilities, are presented together with a method of classifying the level. (auth)

30144 ANOMALY OF THERMAL EXPANSION NEAR THE MAGNETIC COMPENSATION TEMPERATURE IN RARE EARTH FERRIMAGNETS. Nikitin, S.A.; Kim, D.; Zvezdin, A.K.; Popkov, A.F. (Moscow State University). JETP Lett. 22: No. 5, 137-139 (5 Sept 1975).

Anomalies of the thermal expansion were observed in the presence of a magnetic field near the magnetic-compensation temperature T_c in the compound $ErFe_3$ and in dysprosium iron garnet. It is shown that these anomalies can be attributed to a change in the magnetostriction contribution upon reorientation of the magnetic moments of the sublattices and formation of angle structures near T_c. (auth)

30145 WEAKENING OF METALS DURING THE SUPERCONDUCTIVE TRANSITION. Pashitskiy, E. A.; Gabovich, A. M. (Acad of Sci, Ukr SSR). Phys. Met. Metallogr. (USSR) (Engl. Transl.); 36: No. 1, 176-177(1973).

Reduction in activation energy during the transition to the superconducting state is shown to be related to the recovery of the free energy of the superfluid component of conduction electrons screening the perturbation of positive ion exchange in the region of lattice deformation near a dislocation.

30146 THERMIONIC EMISSION FROM A NIOBIUM SINGLE CRYSTAL. Leblanc, R. P.; Vanbrugghe, B. C.; Girouard, F. E. (Univ de Moncton, NB). Can. J. Phys.; 52: No. 17, 1589-1593 (1 Sep 1974).

A spherical projection diode is used to determine the Richardson constants from a niobium spherical single crystal. Work function and A_R values are reported for the [110], [111], [112], [113], [116], [001], and [310] crystallographic directions. Examination of the crystal surface reveals plateau-like surface structure, thermal etch pits, and whisker growth. (14 references)

30147 PLASTICITY OF LEAD IN THE MIXED STATE OF SUPERCONDUCTIVITY AT 4.2°K. Patzak, R.; Stangler, F. (Univ. of Vienna, Austria). Cryst. Lattice Defects; 5: No. 2, 83-88(1974).

The plasticity of lead single crystals was investigated by transposing them into the state of normal conductivity, superconductivity, and into the mixed state by means of a superconducting solenoid. Differences in the shear stress were obtained which were dependent on the magnetic field within the limits of the mixed state. It was possible to prove the dependence of this reaction on the rate of the deformation. An interaction between the dislocations and flux lines was determined, being dependent on the density of flux lines in the mixed state. (13 references)

30148 DISLOCATION VELOCITIES IN INDIUM ANTIMONIDE. Mihara, M.; Ninomiya, T. (Univ. of Tokyo). Phys. Status Solidi (a); 32: No. 1, 43-52(16 Nov 1975).

Velocities of individual α-, β-, and screw dislocations in InSb have been determined by the double-etch technique. It has been shown that α-dislocations are 10^2 to 10^3 times as fast as the other types of dislocations, whereas β- or screw dislocations are the slowest depending on the applied stress. The velocity data can be well fitted with two theories: the abrupt kink model and the dragging point model. The stress dependence of the activation energy is successfully described by the abrupt kink model. (auth)

30149 EXTENSION OF CRYSTAL SPECTROSCOPY TO SMALL QUANTUM ENERGIES BY A MEASUREMENT OF THE YTTRIUM M SPECTRUM. Riehle, F.; Ulmer, K. (Univ., Karlsruhe, Ger.). Phys. Status Solidi (a); 32: No. 1, K23-K27(16 Nov 1975).

Results of investigation of the yttrium M spectrum obtained using a soft x-ray spectrometer. Results are summarized in tables. It was found that x-ray precision spectroscopy with crystals can be extended to very low quantum energies and compare favorably with other methods used in this energy range. (JRD)

30150 MOESSBAUER STUDIES OF Fe–Se, Fe–Sb, Fe–Pr, AND Fe–Nd ALLOYS. Lal, K. B.; Mendiratta, S.; Rao, G. N. (Indian Inst. of Tech., Kanpur). Phys. Status Solidi (a); 32: No. 1, K79-K83(16 Nov 1975).

Measurements on isomer shifts, quadruple splittings, and magnetic hyperfine splittings on α- Fe–Se, β- Fe–Se, mixed α, β, Fe–Se, ϵ- Fe_3Sb_2, $PrFe_7$, and $NdFe_7$ are reported. The results are tabulated and discussed using charts of Moessbauer spectra for these compounds. (JRD)

30151 MEASUREMENT OF ENTHALPY OF MIXING IN THE INDIUM–LEAD–ANTIMONY TERNARY SYSTEM BY QUANTITATIVE THERMOGRAPHIC ANALYSIS. Vecher, A. A.; Gorbacheva, A. I.; Mechkovskii, L. A.; Skoropanov, A. S. (Belorussian State Univ., Minsk). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 6, 928-929(Jun 1975).

Translated from Zh. Fiz. Khim.; 49: No. 6, 1569-1570(Jun 1975).

Heats of formation of indium–lead–antimony ternary alloys at 905°K have been measured by quantitative thermographic analysis. The results are plotted as isoenthalpy lines on the concentration triangle. The maximum enthalpy of mixing of -990 ± 30 cal g-atom^{-1} corresponds to the composition (at.%) 50 Sb + 7.8 Pb + 42.2 In. (auth)

30152 IMPROVING THE QUALITY OF BILLETS AND TUBES BY MICROALLOYING AUSTENITIC STEEL WITH RARE-EARTH ELEMENTS. Ostrenko, V. Ya.; Ermolov, I. V.; Zhalybin, V. I.; Tarasenko, V. A.; Derbasov, V. I. Metall. Gornorudn. Prom-st.; No. 3, 36-37(1975). (In Russian)

Methods of improving the structure and mechanical properties of austenitic Cr–Ni steel of the 0Kh17N16M3T type by the addition of traces of rare-earth elements are considered. The incorporation of ferro-Ce constitutes one convenient means of introducing such elements. The microalloying of austenitic steel with rare-earth metals greatly enhances the ductility. The rare-earth additives play a major part in freeing the grain boundaries from contamination with excess phases (the σ-phase, nitrides, and carbonitrides). The chemical homogeneity is also improved.

30153 EQUATION OF STATE OF 347 STAINLESS STEEL TO 384 GPa. Morgan, J. A. (Los Alamos Scientific Lab., NM). High Temp.–High Pressures; 7: No. 1, 65-70(1975).

The Hugoniot locus for 347 stainless steel has been measured from 183 to 384 GPa with the use of a two-stage gun. A quadratic least-squares fit of these data in addition to those of McQueen et al. (High Velocity Impact Phenomena. Academic Press. New York. (1970)) in the shock velocity, u_s, particle velocity, u_p, plane is given by $u_s = 4.43 + 1.63u_p - 0.0427u_p^2$[km s^{-1}]. Calculations of parameters on the Hugoniot, the release isentrope, the zero Kelvin isentrope and the 293°K isotherm based on the experimental Hugoniot, a Debye specific heat, and a constant $(\delta E/\delta P)_\rho$ are given. (auth)

30154 STRUCTURAL INVESTIGATIONS ON CERIUM AT HIGH PRESSURE. Schaufelberger, P.; Merx, H. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). High Temp.–High Pressures; 7: No. 1, 55-63(1975).

From 4th international conference on high pressures; Kyoto, Japan (25 Nov 1974).

"In situ" x-ray data for cerium have been obtained between 20 and 100 kbar with the use of the Bragg-Brentano parafocusing x-ray reflection technique under quasi-hydrostatic conditions. From these data, the compressibility of α and α' phases has been calculated; a sudden reduction in volume of the α phase amounting to ~6% has been found at 51 ± 1 kbar. The α' phase yields a somewhat intricate x-ray pattern which can be partially resolved by attributing it to a mixture of isodensity fcc and hcp phases. The identity of possible third metastable component is discussed in the light of indexation reliability calculations. (auth)

30155 STUDIES ON THE CALIFORNIUM METAL SYSTEM. Haire, R. G. (Oak Ridge National Lab., TN); Asprey, L. B. Inorg. Nucl. Chem. Lett.; 12: No. 1, 73-84(1976).

It is stated that the preparation of the transplutonium metals through californium has been carried out by two methods: (I) the reduction of a halide with lithium (or barium) metal at elevated temperatures, removing the excess reductant and lithium halide by vacuum distillation; or (II) reducing the oxide with thorium or lanthanum metal and distilling and condensing the actinide metal. Each approach has advantages and disadvantages. In the present work, multimicrogram amounts of ^{249}Cf metal were prepared by the distillation technique, using La metal as the reductant and submilligram quantities of high-purity Cf_2O_3. The resulting Cf metal deposits were analyzed by x-ray diffraction using standard powder methods, and the results of these studies are presented. (UK)

30156 ENERGY DISTRIBUTION OF SPUTTERED CLUSTERS. Koennen, G. P.; Tip, A.; de Vries, A. E. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam). Radiat. Eff.; 26: No. 1-2, 23-29(Sep 1975).

A previous model (Können et al., Rad.Effects;21:269(1974)) on dimer sputtering is extended to the formation of larger clusters. The general formalism for the calculation of the momentum distribution function of these clusters is given. A simple analytical expression is obtained for the distribution function of any cluster in the high energy limit. Comparison of this expression with experimental data on the energy and angle distribution of W_k^+ clusters at high energies shows good agreement. The experimental results on K_2 and KI sputtering with low energies are recompared with the theory. For the ionic crystal KI, evidence is obtained that sputtering of non adjacent K and I atoms from the lattice gives an important contribution to dimer formation. The role of the binding energy E_b of the particles with respect to the surface is discussed. (auth)

30157 NON-MUFFIN-TIN EFFECTS ON THE ELECTRONIC STRUCTURE OF NIOBIUM. Elyashar, N. Chicago; Univ. of Illinois (1975). 99p. University Microfilms Order No. 76-2280.

Thesis (Ph. D.).

Self-consistent relativistic augmented-plane-wave energy-band calculations have been carried out for niobium. These calculations were performed without making any of the usual shape approximations (such as the muffin-tin). The most significant Fermi-surface changes occur in the GAMMA centered hole octahedron sheet. Two experimentally observed orbits on this sheet that are not found in the muffin-tin calculation, are properly accounted for when both relativistic and non-muffin-tin terms are taken into account. An attempt was made to improve the calculated results by modifying the exchange. It was found that increasing the exchange parameter alpha from the Kohn–Sham–Gaspar value (2/3) initially used to .705 in the self-consistent calculation gave results in worse agreement with the de Haas–van Alphen measurements. The non-muffin-tin and self-consistency effects are more pronounced in the wavefunctions (and thus the wavefunction dependent properties) than in the energies or Fermi surface. Some effects immediately seen are (a) strong contributions to the L equals 4 component of the density from the nonspherical charge density of the incompletely filled d-shells; (b) a 7 percent decrease in the interstitial charge due to self-consistency, and (c) nonuniform shifts of the order of 2 percent to 3 percent in the angular momentum character of the wavefunctions due to nonspherical terms-generally in the direction of increased anisotropy. (Diss. Abstr. Int., B)

30158 QUASIPARTICLE INTERFERENCE PHENOMENA AND PHONON DAMPING IN THICK SUPERCONDUCTING INDIUM FILMS. Vopat, F. E. Notre Dame, IN; Univ. of Notre Dame (1975). 179p. University Microfilms Order No. 76-2343.

Thesis (Ph. D.).

The present experimental study deals with quasiparticle interference phenomena in thick films (5-35 mu m) of superconducting In overlaid with Al. Tunneling characteristics obtained with such films exhibit well-defined oscillations in the ac resistance, reflecting similar structure in the tunneling density of states. Inferred virtual-state level spacings are employed to obtain precise determinations of the renormalized Fermi velocity v/sub F/ Z_0, as well as the energy dependence of the renormalization function Z (E) characterizing electronic band structure modifications due to the electron-phonon interaction. Rates at which measured virtual-state amplitudes decay with increasing energy are also compared with existing theoretical predictions, and the measured rates are found to exceed predictions obtained in the weak-coupling limit. The first application of quasiparticle interference phenomena to the task of inferring the phonon density of states alpha^{2}F (omega) is described. Measurements of alpha^{2}F (omega) are difficult at these low energies and the present results provide a sixfold improvement in accuracy over previous estimates obtained by a different tunneling method. The imaginary components of Z (E) and DELTA (E) are also obtained during the course of this analysis. (Diss. Abstr. Int., B)

30159 CURRENT DISTRIBUTION, ELECTROMAGNETIC RESPONSE FUNCTION, AND PROXIMITY EFFECT IN SUPERCONDUCTING AMORPHOUS Bi FILMS. Lejeune, J. D. College Station, TX; Texas A and M Univ. (1975). 88p. University Microfilms Order No. 76-3649.

Thesis (Ph. D.).

Kinetic inductance measurements have been used to probe the degree of current distribution uniformity that exists within thin superconduct ng amorphous Bi films. These measurements were made on films having various cross sections which were condensed on both quartz plates and Nb shield planes. The Nb shield plane appeared to smooth the current distribution considerably. Measurements of the kinetic inductance were also used to determine the temperature dependence of the electromagnetic response function in amorphous Bi films. The zero temperature response function for these films was evaluated using strong-coupling theory and gap parameter data derived from tunneling measurements. With this value for the response function, an unambiguous determination of the zero temperature penetration depth, lambda (0), was possible. The proximity effect, which occurs when a normal metal is placed in good electrical contact with a superconductor, was studied using measurements of the kinetic inductance of amorphous Bi films both before and after deposition of a normal overlayer. Data on the transition temperatures of films with and without a normal overlayer were fitted to the Werthamer theory of the proximity effect. From this fit, the value of the electromagnetic coherence length in amorphous Bi was determined. The added temperature-dependent effect produced by an Fe overlayer on the kinetic inductance of a Bi film has been shown to be well explained by the theory of Fulde and Moormann for the spacial dependence of the order parameter. (Diss. Abstr. Int., B)

30160 SOLUBILITY OF HYDROGEN AND DEUTERIUM IN A URANIUM–MOLYBDENUM ALLOY. Powell, G. L. (Union Carbide Corp., Oak Ridge, TN). J. Phys. Chem.; 80: No. 4, 375-381(12 Feb 1976).

The solubility of hydrogen and of deuterium in uranium–0.222 mole fraction molybdenum alloy has been measured over the temperature range from 700 to 1350°K with a precision of +-1 percent. The solubility displays a minimum value near 900°K. A model, which is generally applicable to hydrogen dissolved in other metals, is presented that describes the observed phenomena, that can be extrapolated to lower temperatures, that yields the enthalpy of formation of hydrogen dissolved in the alloy at 0°K, and that suggests a quantum mechanical treatment for interstitial diffusion. (auth)

30161 RELATION BETWEEN SHORT- AND LONG-TERM ELEVATED-TEMPERATURE PROPERTIES OF SEVERAL AUSTENITIC STAINLESS STEELS. Sikka, V. K.; Brinkman,

C. R. (Oak Ridge National Lab., TN). Scr. Metall.; 10: No. 1, 25-28 (Jan 1976).

Purpose is to show how the short-term elevated-temperature ultimate tensile strength (UTS) can be used as a possible index for estimating short- and perhaps long-term creep-rupture strength for several austenitic stainless steels. Creep-rupture strength data were collected on elevated-temperature mechanical properties of types 304 and 316 stainless steel. The data collection was limited to sources that provided both short-term tensile and creep-rupture results with two exceptions. Data points are also used for types 201, 202, 303, 304, 304L, 304H, 316, 316L, 316H, 316N, 321, 321H, 347, and 347L. 10^3, 10^4, and 10^5h creep-rupture strengths are plotted as a function of UTS and used to fit the equation for creep rupture strength: S equals alpha exp beta (UTS). The constants alpha and beta are tabulated for several stainless steels. (DLC)

30162 ANALYSIS OF THE AMPLITUDE-DEPENDENT DAMPING DATA IN TERMS OF THE GRANATO–LUCKE MODEL. Povolo, F. (Comision Nacional de Energia Atomica, Buenos Aires). Scr. Metall.; 10: No. 1, 45-50 (Jan 1976).

The Granato–Luecke dislocation damping model has been used to determine the solute-atom dislocation binding energy in alloys such as Zr–O and Cu–Ge. Plots from the literature on these two systems are analyzed to show that the values for the binding energy are erroneous and should be revised. (DLC)

30163 PERMEABILITY OF NICKEL TO HIGH PRESSURE HYDROGEN ISOTOPES. Louthan, M. R. Jr.; Derrick, R. G. (Savannah River Lab., Aiken, SC). Scr. Metall.; 10: No. 1, 53-55 (Jan 1976).

The equation phi (cc s^{-1} cm^{-1} atm/sup -½/) equals 6.1 x 10^{-2} (root P/root M) exp [-13,200/RT] was found to apply for D, T, and H in Type 201 nickel at 297 to 652°K and 1 to 275 atm. The diffusivity is not concentration dependent. (DLC)

30164 DIRECT OBSERVATION OF (101) ANOMALOUS SLIP IN MOLYBDENUM BY HVEM. Saka, H. (Nagoya Univ., Japan); Matsui, H.; Noda, K.; Kimura, H.; Imura, T. Scr. Metall.; 10: No. 1, 59-62 (Jan 1976).

During the course of a comprehensive study of the dynamical properties of dislocations in high-purity Mo by in-situ deformation experiment in a HVEM, some interesting behavior of dislocations was observed which is believed to have a close connection with the so-called (101) anomalous slip in high-purity transition bcc metals. (DLC)

30165 DIFFERENT CONTRIBUTIONS OF EDGE AND SCREW DISLOCATIONS TO THE PLASTIC DEFORMATION OF Cd SINGLE CRYSTALS. Pascual, R.; Perez, E. (Comision Nacional de Energia Atomica, Bariloche, Argentina). Scr. Metall.; 10: No. 1, 77-81 (Jan 1976).

Flat Cd single crystals were grown having crystallographic orientations which permitted that, at least during the first stages, plastic deformation was controlled by dislocations of predominately edge or screw character. The temperature dependences of flow stress, activation volumes, and activation enthalpies were determined. (DLC)

30166 PSEUDOELASTIC BEHAVIOR AND ITS STRAIN RATE DEPENDENCE IN THERMOELASTIC In–Tl MARTENSITE. Miura, S. (Doshisha Univ., Kyoto); Ito, M.; Nakanishi, N. Scr. Metall.; 10: No. 1, 87-92 (Jan 1976).

Experimental results are reported for single crystals of In-21 and 22 at. percent Tl alloys: (1) The superelastic behavior associated with the martensitic transformation, shape memory effect, and superelasticity in the martensite phase. (2) The strain rate dependence of the pseudoelastic behavior in the martensite phase. (auth)

30167 EXPERIMENTAL OBSERVATION OF THE RELAXATION TIME OF THE ORDER PARAMETER IN SUPERCONDUCTORS. Schuller, I. (Argonne National Laboratory, Argonne, Illinois 60439); Gray, K.E. Phys. Rev. Lett. 36: No. 8, 429-432 (23 Feb 1976).

We have measured directly the relaxation time τ for the superconducting energy gap. We show that near the superconducting transition temperature τ, the relaxation time diverges as predicted by several authors. By also measuring the equilibrium gap Δ we find $\tau \propto \Delta^{-1}$ very near T_c in agreement with the calculations of Schmid and Shön. (auth)

30168 COMMENT ON DE HAAS-VAN ALPHEN MEASUREMENTS IN GADOLINIUM. Schirber, J.E. (Sandia Laboratories, Albuquerque, New Mexico 87115); Schmidt, F.A.; Harmon, B.N.; Koelling, D.D. Phys. Rev. Lett. 36: No. 8, 448-450 (23 Feb 1976).

Fermi-surface cross sections for field along principal symmetry directions for Gd are presented which are in serious disagreement with those of previous investigators. This disagreement stems from the use of an incorrect value for the saturation magnetization. The new frequency values are compared with the results of a relativistic augmented-plane-wave band calculation. (auth)

30169 PROPERTIES OF SUPERCONDUCTING rf SPUTTERED ULTRATHIN FILMS OF Nb. Wolf, S.A.; Kennedy, J.J.; Nisenoff, M. (Naval Research Laboratory, Washington, D.C. 20375). J. Vac. Sci. Technol. 13: No. 1, 145-147 (Jan 1976).

Superconducting niobium films, both cylindrical and planar, have been prepared by rf sputtering in an uhv chamber which is routinely pumped to a residual pressure of 3×10^{-9} Torr (7.6×10^{-7} Pa). The superconducting transition temperature T_c of films with thicknesses greater than 2000 Å was near 9.2 K, the bulk value, while T_c decreased linearly with inverse thickness for films thinner than 1000 Å. Superconductivity was observed for the first time in Nb films thinner than 50 Å; the T_c of a 40 Å film was 4.4 K while for a 27 Å film the onset of the transition was about 2 K. Electrical continuity was maintained down to a nominal film thickness of less than 10 Å, but this film was not superconducting above 1.5 K. These results will be compared with a model which predicts the dependence of T_c on thickness. (auth)

30170 UPS STUDIES OF VIRGIN CO ON W(100). Vorburger, T.V.; Sandstrom, D.R.; Waclawski, B.J. (National Bureau of Standards, Washington, D.C. 20234). J. Vac. Sci. Technol. 13: No. 1, 287-290 (Jan 1976).

The adsorption of CO on W(100) at 80 K has been studied by photoelectron spectroscopy at $h\nu=21.22$ eV, and the results have been correlated with previous data for room temperature adsorption. Initial adsorption produces a peak in the emission spectrum at ~ -7.6 eV (relative to the Fermi energy), which is characteristic of the virgin state of adsorbed CO, as well as additional structures which have been previously shown to be characteristic of α- and β-CO. Upon heating the sample to 260 K the -7.6-eV level is depleted and apparent conversion to the β state occurs as indicated by an enhancement of the emission near -5.5 eV. Additional data taken with $h\nu=16.85$, 26.9, and 40.81 eV are in general agreement with the measurements at 21.22 eV; however, the peak at -7.6 eV for $h\nu=21.22$ eV is shifted to lower kinetic energies by several tenths of an electron volt at the other photon energies. (auth)

30171 ADSORPTION OF NITROGEN ON PERFECT Re(0001) PLANES. Liu, R.; Ehrlich, G. (Coordinated Science Laboratory and Department of Metallurgy, Univerversity of Illinois at Urbana-Champaign, Urbana, Illinois 61801). J. Vac. Sci. Technol. 13: No. 1, 310-313 (Jan 1976).

In probing the effect of surface structure upon chemical interactions at the gas–metal interface, it is essential to document the role of imperfections. This has been done for the chemisorption of molecular N_2 on the basal plane of Re, using a combination of field-emission and field-ion microscopy. At surface temperatures $T_s < 150$ K, a weakly chemisorbed state of nitrogen forms on the perfect (0001) plane. On warming, this desorbs without conversion to atomically bound material. At 300 K, the (0001) plane remains bare, even after exposure to $> 3\times10^{19}$ molecules/cm^2, while the rougher planes are saturated with nitrogen. Direct dissociation of N_2 does not occur on the basal plane of Re. The (0001) plane does fill with atomically bound nitrogen at $T_s \geq 550$ K. This step appears to involve diffusion of the dissociated gas from adjacent, atomically rough surfaces on which molecular dissociation is relatively rapid. (auth)

30172 HYDROGEN AND HELIUM IMPLANTATION IN VITREOUS SILICA. Mattern, P.L.; Thomas, G.J.; Bauer, W. (Sandia Laboratories, Livermore, California 94550). J. Vac. Sci. Technol. 13: No. 1, 430-436 (Jan 1976).

The effects of 150–300-keV He^+ and H^+ implantation in vitreous silica have been examined by optical absorption spectroscopy, optical and scanning electron microscopy, gas reemission measurements, and microtopography. No surface blistering or exfoliation was observed at any implant temperature ($\lesssim 200°$ to $\sim 800°$ C), at fluences in excess of 10^{19} ions cm^{-2}. The amount of compaction of the implanted layer was determined for high-fluence ion implantation and compared with existing data. Optical absorption studies show evidence for beam-assisted chemisorption, defect formation, and, with hydrogen implantation, the formation of large ($\sim 10^{22}$ cm^{-3}) concentrations of hydroxyl. Experimental results are correlated with gas diffusivity and solubility. Implications for fusion reactor applications are discussed. (auth)

30173 TOMASCH-EFFECT-INDUCED NEGATIVE-RESISTANCE PHENOMENA IN SINGLE-CRYSTAL SUPERCONDUCTING Pb FILMS. Haywood, T.W.; Baker, J.W.; Mitchell, E.N. (Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514). Phys. Rev. B 13: No. 5, 1975-1979 (1 Mar 1976).

A negative-resistance region has been observed just above the gap in tunnel junctions fabricated on ⟨110⟩-oriented single-crystal Pb films. This phenomenon was found to be present only when tunneling into single-crystal Pb films about 1.4 μm thick. When these junctions were

raised to temperatures above 3.7°K or placed in a parallel applied magnetic field above 200 G the negative resistance was not present although a deep minimum in conductance persisted. The structure was always accompanied by large Tomasch oscillations and appears to be related to the presence of the Tomasch effect and the details of the effect as they occur in ⟨100⟩-oriented single-crystal Pb films. The negative resistance and accompanying structure were reproduced in some respects by theoretical calculations using a superconductor density of states modified by the Tomasch term. (auth)

30174 EXCITATION OF GIGAHERTZ MAGNETOELASTIC WAVES IN DYSPROSIUM FILMS: FREQUENCY DEPENDENCE. Wang, J.T.; O'Donnell, M.; Blackstead, H.A. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. B 13: No. 5, 2044-2053 (1 Mar 1976).

Application of a tunable spin-phonon spectrometer to the study of microwave phonon excitations over more than an octave in frequency in polycrystalline films of dysprosium is shown to provide direct information about the coupled magnetoelastic modes. In particular, experiments demonstrate that a rf magnetic field couples to the "phononlike" branch of the magnetoelastic dispersion curves, and the attenuation of the rf field in the films leads to $q \neq 0$ momentum conservation. The observed phonon signal intensity at the rf frequency ν_0 is shown to be in excellent agreement with intensities computed from the coupled-mode dispersion relations. (auth)

30175 SPECIFIC HEAT AND THERMAL EXPANSION OF SOLIDS AT HIGH TEMPERATURE. Hoch, M.; Vernardakis, T. (Univ. of Cincinnati). Scr. Metall.; 9: No. 11, 1131-1133(Nov 1975).

The theoretical relations between d, alpha_0, and alpha_1, where d reflects the influence of any anharmonic vibrations within the lattice, and alpha_0 and alpha_1 express the coefficient of thermal expansion, as established by different equations, are compared. Data on the specific heats of Mo, W, Nb, Ta, Al_2O_3, and UO_2 are compared and tabulated. (JRD)

30176 REVISED METHOD FOR CALCULATING gamma-PHASE COMPOSITIONS IN NICKEL-BASE SUPERALLOYS. Mongeau, D. E.; Wallace, W. (National Research Council of Canada, Ottawa). Scr. Metall.; 9: No. 11, 1185-1188(Nov 1975).

A method of calculating gamma phase compositions in Ni-base superalloys is described in which the volume fraction of gamma' obtained using a regression equation is refined using an iteration procedure and the refined value is then used to compute the gamma and gamma' compositions using further regression equations. The method is applied to heats of Udimet 700 and In 738. Resulting data are tabulated and analyzed. (JRD)

30177 CRITICAL ELECTRON-VACANCY CONCENTRATIONS AND sigma FORMATION IN UDIMET 700. Mongeau, D. E.; Wallace, W. (National Research Council of Canada, Ottawa). Scr. Metall.; 9: No. 11, 1189-1193(Nov 1975).

The gamma-phase compositions and the gamma' volume fractions are tabulated for 12 heats of Udimet 700. Values for the average electron-vacancy concentrations and the critical values for the gamma-phase at 870°C are also tabulated. The results support a model of Barrows and Newkirk [Met. Trans., 3: 2889 (1972)] in which the gamma phase boundary is described in terms of electron-vacancy concentration and temperature and show that this method can be used with computed gamma matrix compositions. Confidence in this method should increase as further comparisons between observed and predicted sigma forming propensity are carried out for other alloys and when the role of non-transition elements such as Al is better understood. (JRD)

30178 SEMI-CONE ANGLES IN CONICAL TERBIUM–ERBIUM AND DYSPROSIUM–ERBIUM ALLOYS. Sano, N.; Shimizu, K.; Aoki, Y.; Itoh, J. J. Phys. Soc. Jpn.; 39: No. 1, 93-97(Jul 1975).

The semi-cone angles of Tb and Er in Tb–Er alloys and of Dy and Er in Dy–Er alloys are calculated by analyzing the results of spin-echo measurements on these alloys. The angles of individual components are different from each other, indicating a double-cone structure. A simple molecular-field calculation shows that a double-cone structure is the most stable one in these alloys, provided that the exchange and anisotropy constants are chosen correctly.

30179 EFFECT OF MAGNETISM ON THE SOLUBILITY OF BERYLLIUM IN ALPHA IRON. Ko, M.; Nishizawa, T. Trans. Jpn. Inst. Met.; 16: No. 6, 369-371(Jun 1975).

Binary Fe–Be alloys were homogenized at elevated temperature, and the lattice parameter of the α-Fe–Be solid solution was determined as a function of Be concentration by means of an x-ray diffraction technique. The solubility limit of Be was determined by measurements on specimens which had been annealed at 50°C intervals from 600 to 950°C. The results show that deviation in the solubility curve of α-Fe–Be occurs around the Curie temperature and this deviation is due to the magnetism of the solid solution.

30180 METHOD OF DETERMINING THE SOLUBILITY OF THE CARBIDE PHASE IN HIGH ALLOYS. Tomilin, I. A.; Gernets, L. V. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 41: No. 5, 669-671 (May 1975).

Translated from Zavod. Lab.; 41: No. 5, 546-548(May 1975).

A proposed method is described which makes it possible to determine the solubility of the carbide phase in alloys containing, in addition to the metal solvent and carbon, alloying elements participating in carbide formation. The essence of the method is that two alloy samples are prepared having an identical content of alloying elements. To one of these samples is added a small amount of carbon to a concentration exceeding the solubility limit of the carbide phase. However, in this case the amount of formed carbide phase must be such that a noticeable change does not occur in concentration of the alloying element in the solid solution. The two-phase sample prepared in such a way is welded to a sample of alloy not containing carbon. Equalization of the carbon concentration in solid solution in the two samples occurs upon aging at a chosen temperature. As a result a concentration corresponding to the solubility limit is reached in the sample, not containing carbon earlier. The proposed method was used for the determination of the solubility of carbon in an alloy on the nickel–molybdenum system of the following composition: 27.8 wt.% Mo, <0.1 wt.% Si, <0.5 wt.% Fe; the remainder is Ni. (auth)

30181 AC LOSSES OF V_3Ga TAPES. Horigami, O. (Brookhaven National Lab., Upton, NY); Bussiere, J. F.; Tanaka, Y. Cryogenics; 15: No. 11, 660-664(Nov 1975).

60 Hz losses, measured at 4.2°K, are reported for a number of V_3Ga tapes reacted between 625 and 775°C for various lengths of time. The losses are shown to depend mainly on the bulk critical current density J_c, except at low fields (≲500 Oe) where surface currents, and hence surface roughness, play a dominant role. Measurements of losses in a dc bias field indicate that the surface currents are strongly field dependent whereas the bulk J_c has a much slower field dependence. (auth)

30182 MIXED STATE IN SINGLE CRYSTAL LEAD FILMS. Singh, O.; Curzon, A. E. (Simon Fraser Univ., Burnaby, British Columbia). Cryogenics; 15: No. 11, 665-666(Nov 1975).

The mixed state in single crystal films of lead has been observed using Essman and Trauble's technique and a scanning electron microscope. Single crystal films were grown epitaxially on heated substrates of mica and MoS_2. Films of thickness 2000 Å or less show a single fluxoid state while in thick films the multifluxoid state is observed. (auth)

30183 THERMAL CONTACT OF MOESSBAUER SOURCES FAR BELOW 4.2°K. Research and Technical Note. Bogner, L.; Seidel, E. R. (Technische Univ., Munich). Cryogenics; 15: No. No. 11, 680-682(Nov 1975).

The thermal contact of a Moessbauer source connected to a copper cold finger by the solder $Ga_{40}In_{60}$ which is liquid at room temperature has been investigated. The measurements were carried out in the range between 1 and 0.07°K. A source of 2.5 mCi of carrier-free ^{57}Co diffused into a 25 μm thick foil of ^{56}Fe was mounted onto the bottom of the mixing chamber of a $^3He/^4He$ dilution refrigerator. The source temperature was measured by the intensity ratio of the hyperfine lines in the Moessbauer spectra recorded with an absorber of calcium hexaferrocyanide (0.25 mg $^{57}Fe,cm^{-2}$). It was shown that the source-temperature followed the temperature of the copper bottom over the whole temperature region studied showing that a very good thermal contact had been achieved. It is concluded that the measurements show that the liquid solder $Ga_{40}In_{60}$ can be successfully used for thermal coupling of Moessbauer sources even at very low temperatures and quite high heat loads. In cases where good wetting of the surfaces by the solder cannot be achieved easily, the use of ultra-sound soldering equipment has been shown to be successful. With such contacts the Moessbauer source thermometer appears to work quite well in the temperature region around 0.05°K. (UK)

30184 SUPERCONDUCTING COILS IMPREGNATED WITH WOOD'S METAL. Kuroda, K. (Hitachi Ltd., Tokyo). Cryogenics; 15: No. 11, 675-677(Nov 1975).

Tests on the effect on superconducting coils of impregnation with Wood's metal, are reported. Coils which show remarkable training effect or degradation in excitation were selected for the work. These characteristics before and after impregnation are shown graphically. It is concluded that the impregnation method using metals with a low melting point such as Wood's metal is effective in suppressing instability in superconducting coils. As the training effect and current degradation in superconducting coils depend strongly on wire movement in the winding, wire movement must

first be prevented even if other possible origins of instability are considered. (UK)

30185 DETERMINATION OF MEAN-FREE-PATHS IN INDIUM FROM THE RADIO-FREQUENCY SIZE EFFECT AND THE PEAK NEAR-ZERO FIELD. de Groot, D. G.; Hoff, A. B. M.; van Weeren, J. H. P. J. Phys., F (London); 5: No. 8, 1559-1567(Aug 1975).

The rf size effect with a magnetic field parallel to the surface of the specimen has been used to determine mean-free-paths in In. The phonon-limited mean-free-path, l_p, for carriers on the second-zone surface was determined from the temperature dependence of the amplitude, A_T, of the size effect. A cubic dependence of l_p^{-1} on temperature was found. However, in some cases deviations from the expected behavior of the amplitude $\ln A_T = a - bT^{-3}$, where a and b are constants, have been recorded. From the field position of the extremum of the peak near-zero field, values of the carrier mean-free-path have been extracted. The preliminary results of both methods agree fairly well.

30186 PSEUDODIPOLE EXCHANGE ANISOTROPY IN RARE-EARTH INTERMETALLIC COMPOUNDS. Kazakov, A. A. Fiz. Tverd. Tela; 17: No. 8, 2309-2311(Aug 1975). (In Russian).

Pseudo-dipole exchange effects in rare-earth intermetallic compounds are discussed theoretically in relation to the electrical, magnetic, and optical characteristics of these materials. An expression is derived for the indirect-exchange Hamiltonian between the 3d and 4f electrons. In addition to the isotropic contributions, the Hamiltonian contains considerable anisotropic pseudo-dipole terms. The dependence of the exchange energy on distance may here differ from the Ruderman–Kittel function. The anisotropy changes sign on passing along the series of rare-earth elements at the same point as the single-ion crystallographic anisotropy. The effect is specially noticeable for compounds of the RCo_5 type (R = rare-earth).

30187 WORK FUNCTION OF THE (100) FACE OF MOLYBDENUM WITH MONATOMIC CHLORINE, BROMINE, OR IODINE FILMS ADSORBED UPON IT. Chaikovskii, E. F.; Pyatigorskii, G. M.; Derkach, Yu. F. Fiz. Tverd. Tela; 17: No. 8, 2403-2404 (Aug 1975). (In Russian).

The work function of the (100) face of a Mo single crystal carrying adsorbed Cl, Br, or I films was studied by determining the surface-ionization characteristics of KCl, RbCl, CsCl, CsBr, and CsI molecules on this face. Using the KCl date the work function of Mo carrying a monatomic film of Cl was estimated as 5.5 eV; indirect comparison with existing data yielded excellent agreement, so justifying the extension of the same method to Br and I films. The corresponding work functions were 5.45 and 4.65 eV, respectively. Existing data were insufficient to make a rigorous comparison of these values; however, indirect evidence again suggested their reasonableness.

30188 ELASTIC SCATTERING OF ELECTRONS DURING THE ADSORPTION OF GOLD ON BERYLLIUM AND BERYLLIUM ON GOLD. Bronshtein, I. M.; Pronin, V. P. Fiz. Tverd. Tela; 17: No. 8, 2502-2504(Aug 1975). (In Russian).

The elastic scattering of electrons with initial energies of ~1 keV in Au films deposited monolayer by monolayer on Be, and Be films similarly deposited on Au, was studied. Even for a single Au monolayer the general pattern of reflected electrons appeared very similar to that given by a solid Au target; the electrons penetrated no more than three atomic layers (10 Å), and possibly 70% were reflected from the top one. In the case of Be deposited on Au the angular distribution for 20 monolayers approached that of bulk Be; apparently the electrons penetrated at most to a depth of 40 atomic layers or 90 Å.

30189 STUDY OF TUNNELING IN SUPERCONDUCTOR INDIUM–TIN ALLOYS. Galkin, A. A.; Svistunov, V. M.; Revenko, Yu. F.; Mostovol, V. M. (Inst. of Physics and Engineering, Kiev). Sov. Phys.–Solid State (Engl. Transl.); 17: No. 5, 968-969(May 1975).

Translated from Fiz. Tverd. Tela; 17: No. 5, 1490-1493(May 1975).

The tunnel effect was studied in film junctions of the α phase of In–Sn alloys. Energy gaps were calculated from the dI/dV curve and phonon spectrum changes from the d^2V/dI^2 curves. The critical temperature was also determined. Relation of $2\Delta_0/T_c$ to the phonon frequency was determined. (DLC)

30190 ELECTRON WORK FUNCTION OF THE (100), (111), AND (110) FACES OF SINGLE CRYSTALS OF ALLOYS OF TUNGSTEN WITH TANTALUM. Dyubua, B. Ch.; Solov'eva, G. S.; Rozhdestvenskii, V. M.; Kurakina, L. A. Sov. Phys.–Solid State (Engl. Transl.); 17: No. 5, 979-980(May 1975).

Translated from Fiz. Tverd. Tela; 17: No. 5, 1503-1505(May 1975).

A study was made of the principal faces of large alloy single crystals whose compositions are in the W-base solid-solution range (4 to 9% Ta). The work functions were measured over the temperature range 1500 to 2250°K. The temperature dependence indicates the following ascending order of bond energy between Ta and the crystal faces: (110), (100), (111). (DLC)

30191 OBSERVATION OF THE SPLITTING OF DISLOCATIONS IN (123) TUNGSTEN PLANES. Orlov, L. G.; Potapov, L. P.; Shiryaev, P. P. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Sov. Phys.–Solid State (Engl. Transl.); 17: No. 5, 917-918(May 1975).

Translated from Fiz. Tverd. Tela; 17: No. 5, 1426-1428(May 1975).

A method for analyzing field-ion emission patterns of samples containing stacking faults is discussed. A model of splitting of (a/2) ⟨111⟩ dislocations in {123} planes in tungsten is considered. An analysis of the field-ion images shows that such splitting can indeed occur. (auth)

30192 SOME DOSIMETRIC CHARACTERISTICS OF THE RADIOTHERMOLUMINESCENT SYSTEM MgF_2:Mn. Paun, J.; Jipa, S. (Polytechnical Inst., Bucharest). Radiochem. Radioanal. Lett.; 24: No. 4, 263-273(20 Feb 1976).

The main dosimetric characteristics of RTL-system MgF_2:Mn such as dose response, dose rate dependence, fading, energy response and light influence on the RTL signal have been studied. These features recommend it as an efficient and reliable phosphor in professional dosimetry. (auth)

30193 DIFFUSION OF NUCLEAR REACTION PRODUCTS IN α- THORIUM. Reetz, T.; Eichler, B. (Joint Inst. for Nuclear Research, Dubna (USSR)). Kernenergie; 18: No. 6, 162-165(1975). (In German)

Diffusion coefficients have been determined by measuring the release rates of the nuclear reaction products Ac, Ag, Bi, Ce, Cs, I, Pb, Po, Ra, Rb, Sb, Sr, and Y from a α-thorium metal at temperatures ranging from 960 to 1330°C. The diffusion coefficients depend on the atomic volume of diffusing atoms. The quantity $d \lg D_o/dQ$ is correlated with atomic volume, heat of melting, and melting temperature of the host metal for face-centered cubic metals. (INIS)

30194 SPIN-PHONON INTERACTIONS IN THE HEISENBERG-FERROMAGNET. Viljoen, J. du P. Johannesburg; Rand Afrikaans Univ. (1974). 116p. (In Afrikaans). INIS.

Thesis.

Spin-phonon interactions are studied in a simple model of a ferromagnetic crystal over the whole temperature range below the Curie-temperature T_c, by making use of the method of double-time temperature-dependent Green functions. At low temperatures ($T \ll T_c$) the Tyablikov-approximation is used, while at temperatures close to T_c the random phase approximation is applied. The effect of the spin-phonon interactions in the long wave-length limit on the sound velocity in the crystal is studied. The results obtained are in qualitative agreement with the observed anomalous temperature behavior of the sound velocity below T_c in certain ferro- and antiferromagnets.

30195 MAGNETOELASTIC PROPERTIES OF (RARE-EARTH)–CO_2 COMPOUNDS. I. Exchange-Striction. Lee, E. W.; Pourarian, F. (Univ. of Southampton, Eng.). Phys. Status Solidi (a); 33: No. 2, 483-489(16 Feb 1976).

The exchange-striction of the cubic Laves-phase compounds RCo_2 (R = Pr, Nd, Tb, Dy, Ho, and Er) was determined at 0°K from measurements of the thermal expansion. Results are interpreted in terms of a two-sublattice model involving R–Co and R–R interactions. The former are the more important.

30196 DIFFUSION COEFFICIENT, HEAT OF TRANSPORT, AND SOLUBILITY LIMIT OF H IN V. Heller, R.; Wipf, H. (Univ., Munich). Phys. Status Solidi (a); 33: No. 2, 525-529(16 Feb 1976).

The quantities were determined by resistance measurements. The experiments were performed below room temperature and with H concentrations up to 1.29 at.%. For the diffusion coefficient, a very low activation energy of (0.040 ± 0.005)eV was found. The heat of transport is (0.017 ± 0.003)eV. The solubility limit, measured between 120 and 270°K, can be described with a precipitation enthalpy of (0.13 ± 0.01)eV. (auth)

30197 X-RAY AND MAGNETIC INVESTIGATIONS OF THE HIGH-TEMPERATURE PHASE IN THE Co-RICH Co-V ALLOY SYSTEM. Aoki, Y.; Yamamoto, M. (Tohoku Univ., Sendai). Phys. Status Solidi (a); 33: No. 2, 625-632(16 Feb 1976).

X-ray and magnetic studies were carried out for the fcc Co–V alloys containing V up to 30.1 at.%. The x-ray measurements showed that the lattice parameter does not obey Vegard's law in the observed composition range. The composition dependence of the lattice parameter can be related to the magnetic moment. The saturation moment and the Curie point decrease with in-

creasing V content, and the alloy shows a transition from ferromagnetism to paramagnetism near 23 at.% V. The magnetic behavior of these alloys is discussed in connection with the magnetic properties of the ordered hexagonal VCo_3 compound. 6 figures. (auth)

30198 HIGH-TEMPERATURE THERMAL EXPANSION OF PLATINUM, TANTALUM, MOLYBDENUM, AND TUNGSTEN MEASURED BY X-RAY DIFFRACTION. Waseda, Y.; Hirata, K.; Ohtani, M. (Tohoku Univ., Sendai). High Temp. - High Pressures; 7: No. 2, 221-226(1975).

The thermal expansion of platinum, tantalum, molybdenum, and tungsten was measured between 800 and 2300°C by the x-ray diffraction method. These metals were found to exhibit a nearly uniform expansion over the quoted temperature range. (auth)

30199 ACOUSTIC EMISSION IN THE DEFORMATION OF ZIRCONIUM. Glygalo, V. N.; Kirsanov, V. V.; Kravtsova, L. S.; Leshchinskii, A. G. Sov. J. Nondestr. Test. (Engl. Transl.); 11: No. 3, 392-393(1975).

Translated from Defektoskopiya; 11: No. 3, 140-142(1975).

The acoustic emission (AE) was measured and the data presented in curves of emission intensity vs strain. The AE intensity curve for zirconium can be arbitrarily partitioned into three intervals, each of which is apparently characterized by its own dominant AE mechanism. A proportional variation of the AE intensity with the density of moving dislocations ($\dot{N} \sim \rho_m$) formally describes the behavior of the curve in interval I. As the strain is increased, some of the dislocations lose their mobility due to interaction of emergence at the surface. However, the sharp drop that should occur in the AE intensity according to the relation $\dot{N} \sim \rho_m$ (interval II) is not observed. This disparity can be explained by the intensification of twinning processes, which are a significant part in the plastic strain of zirconium and are a strong source of AE. The annihilation of dislocations and their surface emergence also provide a certain contribution to the AE in interval II. With a further increase in the strain, the growth of the AE intensity (interval III) can be attributed to breakdown in the structural homogeneity, ultimately leading to fracture of the sample. (JRD)

30200 CRYSTAL FIELD IN $Ho_cY_{1-c}Ag$ COMPOUNDS. Tellenbach, U.; Furrer, A.; Millhouse, A. H. (Eidgenoessiches Inst. fuer Reaktortechnik, Wuerenlingen, Switzerland). J. Phys., C (London); 8: No. 22, 3833-3840(21 Nov 1975).

Neutron inelastic scattering experiments have been performed to measure the crystal-field splittings of the $^5I_8$ ground state multiplet corresponding to the Ho^{3+} ion in $Ho_cY_{1-c}Ag$ compounds. The resulting crystal-field parameters turn out to be independent of the rare earth concentration. Additional information has been obtained on the strength of the molecular field. The parameters derived from the neutron experiments give an excellent description of the magnetic properties of HoAg. (auth)

30201 EXCHANGE FORCE EXPLANATION FOR THE ANTIFERROMAGNET-FERROMAGNET TRANSITION IN DYSPROSIUM. del Moral, A.; Lee, E. W. (Univ. of Southampton, Eng.). J. Phys., C (London); 8: No. 22, 3881-3886(21 Nov 1975).

An explanation based on exchange forces is proposed for the antiferromagnet-ferromagnet transition in Dy which is in good agreement with the available experimental results. Contrary to the usual idea that the driving mechanism is the magnetostriction and anisotropy in the basal plane of the hcp structure, it is shown that the exchange forces are mainly responsible for the transition. Magnetoelastic, anisotropy and applied magnetic field energies only provide the delicate balance of energy necessary to assist the exchange forces for the transition. These energies only amount to a relatively small fraction (<20%) of the total driving energy. (auth)

30202 ELECTRONIC SPECTRUM OF A METAL CONTAINING TRACES OF HYDROGEN. Solov'ev, G. S. Zh. Eksp. Teor. Fiz.; 68: No. 4, 1324-1330(Apr 1975). (In Russian)

A theory is presented for the electronic spectrum of a metal containing a small number of H atoms. Special attention is paid to the part played by the bound electrons in the region of the protons. The electron energy of the system is calculated on the basis of the Hartree self-consistent-field approximation, allowing for the many-particle nature of the electron "liquid" and the effect which this discrete structure has on the development of bound states. Electronic structures involving one or two bound electrons close to the proton are energetically more favorable than those based on free electrons only. Examples are given for electrons in Ti, Pt, Fe, Zr, Cu, and other metals.

30203 APPLICATION OF THE PSEUDOPOTENTIAL METHOD TO THE CALCULATION OF THE TEMPERATURE OF PHASE TRANSITIONS. Fuks, D. L.; Zhorovkov, M. F.; Panin, V. E. (Tomsk State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 80-84(1975). (In Russian).

The pseudopotential formalism was used for the description of the phase transition from the two-phase state to the one-phase state in alloys with limited solubility. The simultaneous use of the pseudopotential and static concentration wave methods for the calculation of the temperature of order-disorder phase transition were generalized to cases of lattices with bases. Numerical calculations were made of the curves of limited solubility in the Cd-Zn system and the order-disorder phase transitions for the superstructures Mg_3Cd, MgCd, and $MgCd_3$. (tr-auth)

30204 X-RADIOGRAPHIC STUDY OF THE INTERMETALLIC COMPOUND $SmCo_5$ AFTER LASER IRRADIATION. Mirkin, L.I.; Smyslov, E. F. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 127-129(1975). (In Russian).

The effects of laser radiation was studied on both cast and powdered $SmCo_5$. In the cast samples x radiographs showed the formation of zones of solidified melts. Metallographic studies showed grain fractionation and increased microhardness. In the powdered samples zones of solidified melts were also observed and the x-ray structural analysis showed the formation of an Sm_2Co_{17} phase with complete absence of the $SmCo_5$ lines or Sm oxides. (JSR)

30205 ELECTRICAL RESISTIVITY OF GADOLINIUM CONTAINING ADMIXED ATOMS OF TERBIUM. Babushkina, N.A.; Zhernov, A.P.; Murav'eva, V.M. Sov. Phys.—Solid State 17: No. 9, 1778-1780 (Sept 1975).

A sudden breakdown in Matthiessen's rule has been found during an investigation into the electrical resistivity of dilute magnetic Gd-Tb alloys in the temperature range 1.5–14 °K. It takes place in the following way: In the low-temperature region the variation of ρ with T ($\Delta\rho \sim T^2$) is slower than in regular metals ($\rho \sim T^2$). In the temperature range of the order of $\theta_c/5$, $\Delta\rho$ passes through a well-defined maximum, indicating a nonlinear dependence on the addition concentration. According to theory, these corrections to the resistivity are associated respectively with the nonretention of the impulse of the system with the electron scattering at the dynamically disordered spin regions and with the isotropization of the distribution function of the electrons f_k. (auth)

30206 LOW-TEMPERATURE MAGNETIZATION CURVES OF SMALL PARTICLES OF GADOLINIUM. Gen, M.Ya.; Kostygov, A.N.; Petinov, V.I.; Petrov, A.E.; Stoenko, N.I. (Institute of Chemical Physics, Academy of Sciences of the USSR, Chernogolovka). Sov. Phys.—Solid State 17: No. 9, 1832-1832 (Sept 1975).

The results are given from a study of the magnetic properties of Gd with diameters of 240 and 800 A. (AIP)

30207 THE CRYSTAL STRUCTURE OF THE COMPOUNDS $Ce(Mn_{0.55}Ni_{0.45})_{11}$ AND $U(Ni_{0.68}Si_{0.32})_{11}$. Kalychak, Y.M.; Aksel'rud, L.G.; Yarmolyuk, Y.P.; Bodak, O.I.; Gladyshevskii, E.I. (L'vov State University). Sov. Phys.—Crystallogr. 20: No. 5, 639-640 (Sept 1975).

Interatomic distances and coordination numbers of the atoms in the isostructural (tetagonal space groups P4/mbm) compounds $(Mn_{0.55}Ni_{0.45})_{11}$ and $LI(Ni_{0.68}Si_{0.32})_{11}$ have been determined by x-ray diffraction techniques. (AIP). (auth)

30208 MAGNONS AND INTERFACE MAGNETIC SUBSTRUCTURES. Djafari-Rouhani, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91—Gif-sur-Yvette (France). Service de Physique Atomique); Dobrzynski, L. J. Phys. (Paris); 36: No. 9, 835-849 (Sep 1975). (In French)

The localized magnons at an interface between two Heisenberg ferromagnets and the ferromagnetic stability at the interface are studied. Simple cubic crystals are considered having the same lattice parameter and the same spin value in the fundamental state on each site, but different exchange integrals between first and second nearest neighbors. An interface by coupling two semi-infinite crystals having the same crystallographic surface is defined. The conditions for the existence of localized magnons at (001) interfaces as well as the dispersion curves of localized and resonant magnons in the high symmetry directions of the Brillouin zone are studied. The effect of the interface interactions on these modes is determined. It is shown that magnetic superstructures may exist at (110) interfaces. Such an instability is given by the existence of a soft localized mode at the interface.

30209 SPIN CORRELATIONS AND SCALING LAWS IN MAGNETIC GLASSES. Seiden, J. (Paris-11 Univ., 91—Orsay (France). Inst. d'Electronique Fondamentale). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 11, 153-156(15 Sep 1975). (In French)

Methods of calculating spin correlations in magnetic glasses are proposed along with formulation of scaling laws deduced from them. Elastic diffusion of neutrons and nuclear relaxation are discussed.

30210 Zr-Rh SOLDERING OF REFRACTORY MATERIALS. Schneider, P.; Brabenec, M. (Tesla Vrsovice, Prague (Czechoslovakia)). Vide; 30: No. 177, 147-148(Apr 1975). (In French)

The fundamental properties of the alloy Zr-Rh 25 for soldering carbides, graphites, and alumina ceramics with metals such as molybdenum, tungsten, and tantalum have been studied.

30211 DYNAMIC NUCLEAR POLARIZATION IN LITHIUM HYDRIDE. Roinel, Y.; Bouffard, V.; Glattli, H. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 5, 113-115(4 Aug 1975). (In French)

Nuclear plarizations of 50% for ^{1}H and 35% for ^{7}Li have been obtained in a sample of lithium hydride (LiH) by means of the solid effect at 50kG and 0.6°K. The paramagnetic impurities necessary to the dynamic polarization are F-centers, created by irradiation with 2 MeV electrons.

30212 COMPARISON BETWEEN THE GETTERING QUALITIES OF Zr_5Si_3, Zr AND THE Zr84A116 ALLOY. Schneider, P.; Pokorny, P. (Telsa Vrsovice, Prague (Czechoslovakia)). Vide; 30: No. 177, 149-152(Apr 1975). (In French)

The gettering quality of sintered, pulverized zirconium silicide for various gases as depending on temperature after a previous heating was investigated by topatron. The results obtained have been compared with those of sintered pulverized zirconium and the gettering alloy Zr84A116.

30213 CRITICAL BEHAVIOR IN A FIELD FOR UNIAXIAL FERROELECTRICS AND FERROMAGNETS WITH DIPOLAR INTERACTION. Bervillier, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Physique Theorique). J. Phys. (Paris), Lett.; 36: No. 10, L.225-L.228(Oct 1975).

The logarithmic critical singularities for uniaxial dipolar systems (or for the four dimensional theory) in non zero external field are obtained. The result takes a simple form only for n = 1, n being the number of components of the order parameter.

30214 PLASMON DAMPING IN Be, Mg, Al, Si, Ge AND Sn. Aiyama, T.; Yada, K. (Tohoku Univ., Sendai (Japan). Research Inst. for Scientific Measurements). J. Phys. Soc. Jpn.; 36: No. 6, 1554-1562(Jun 1974).

Characters of the plasma loss of electrons—plasmon energy, dispersion coefficient and angular dependences of both the half-width and the intensity of the loss peak—were measured for Be, Mg, Al, Si, Ge and Sn at 40 kV. The angular dependence of the half-width was analyzed in the form of $\Gamma_p = A + B\theta^2$. As the result, it was found that there were two groups: Al, Mg and Sn belonged to the first group in which A had relatively small values and B was positive, and Ge, Si and Be belonged to the second group in which A had relatively large values and B was negative. The electron-electron interaction would be an important factor of the plasmon damping for the second group. The angular dependence of the intensity agreed with θ^{-2} law for the first group but did not for the second group. An anomalous damping was not observed in amorphous Ge and Si. (auth)

30215 PRESSURE DEPENDENCE OF THE FERMI SURFACES OF INDIUM AND ALUMINUM. A de Haas-van Alphen Study. Harmans, C. J. P. M. Amsterdam; Vrije Univ. (1975). 113p.

Thesis.

An investigation of the Fermi surfaces of indium and aluminum was performed using the de Haas-van Alphen effect. The pressure dependence of several second and third zone orbits was obtained, using both high hydrostatic pressure in solid helium and low hydrostatic pressure in fluid helium. A Heine-Abarenkov-Animalu model potential together with a PSIPW calculation was used to calculate the Fermi surface of indium and its pressure dependence. Overall agreement is obtained between measured and calculated pressure dependence, in particular when the uncertainty of the pressure dependence of the c/a axial ratio is taken into account. Although data obtained from uniaxial measurements seem to support the presented solution, high accuracy elastic constants are needed to establish the correctness of it. The stress dependence of the investigated orbits of aluminum agrees fully with available other experimental data, but it is about five times as accurate. Also good agreement with calculational results occurs. (NL)

30216 CORRELATION FUNCTION OF OSCILLATIONS, MULTIPLY MODULATED BY RANDOM PROCESSES (AS APPLIED TO TWT MODULATION). Zavetnii, V. I.; Sergievskii, B. D. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 20: No. 3, 82-87(Mar 1975).

Translated from Radiotekh. Elektron.; 20: No. 3, 590-597(Mar 1975).

A comparative study is made of the energy spectra of light and heavy ions, scattered by a single crystal. The (110) and (111) faces of a molybdenum single crystal were bombarded with Na^+ and Rb^+ ions at primary ion energies in the range E_0 = 300-3000 eV. It is shown that at relatively low ion energies ($E \lesssim 1$ keV) an examination of the angular characteristics of the scattering of heavier ions is the most effective method for studying both the structure as well as the isotopic and impurity content of a solid. It is found that secondary peaks, caused by isotopic effects of the sample, are present in the energy spectrum of comparatively heavy ions, scattered by a crystal, in addition to the primary peaks corresponding to ions that have undergone single and double collision with atoms of the target.

30217 HYPERFINE INTERACTIONS OF TERBIUM, DYSPROSIUM, AND ERBIUM MAGNETICALLY ORDERED HEAVY RARE-EARTH ALLOYS. Sano, N.; Shimizu, K.; Itoh, J. J. Phys. Soc. Jpn.; 39: No. 1, 84-92(Jul 1975).

Nuclear-Magnetic-Resonance spectra of ^{159}Tb, ^{163}Dy, and ^{167}Er in various heavy rare-earth alloys which are all in magnetically ordered states were investigated at liquid He temperature, and the values of magnetic-dipole and electric-quadrupole hyperfine interactions were determined. In these heavy rare-earth alloys, the main contribution to the hyperfine interactions arises from the unfilled 4f electrons of the parent ion. Other minor contributions exist: the electric-quadrupole interaction arising from the lattice and conduction-electron charges and the internal field produced by the polarization of the conduction electrons.

30218 THEORY OF MAGNETIC-MOMENT ORDERING IN HEAVY RARE-EARTH ALLOYS AT MEDIUM TEMPERATURE. Shibata, T.; Nagamiya, T. J. Phys. Soc. Jpn.; 38: No. 5, 1286-1292(May 1975).

Magnetic phase diagrams for alloys Tb-Er, Dy-Er, and Ho-Er are studied on the assumption of anisotropic energies of the form of DJ_z^2, with opposite signs of D for the two components, and exchange interactions among spins of different magnitudes for the two components. A molecular field approximation is made. Neutron diffraction results are well explained, particularly with respect to the hitherto unexplained transition helix-elliptical oscillation which occurs at a certain concentration range as temperature falls. The effect of higher order anisotropic energies is discussed and is unimportant except at low temperature.

30219 EFFECT OF PLASTIC DEFORMATION ON THE THERMAL CONDUCTIVITY OF INDIUM ANTIMONIDE SINGLE CRYSTALS. Kosarev, V. V.; Popov, V. V.; Tamarin, P. V. Fiz. Tverd. Tela; 17: No. 8, 2507-2509(Aug 1975). (In Russian)

The phonon component of the thermal conductivity of an InSb single crystal was studied before and after plastic deformation (bending a rod-shaped sample at 300°C). Before deformation the sample had n-type and afterwards p-type conductivity. Individual dislocations, twins, and dislocation aggregates were introduced by the bending. In the high-temperature region in which phonon-phonon scattering predominated the thermal conductivity before and after treatment coincided. At lower temperature the undeformed sample had a conductivity ten times that of the deformed sample. Two-dimensional defects were the main cause of this difference.

30220 USE OF RADIONUCLIDES FOR THE DETERMINATION OF METAL VAPOR PRESSURE. Vrestal, J. Isotopenpraxis; 11: No. 12, 444-446(1975).

The vapor pressures of pure Fe, Co, and Ni were determined by the classical differential variant of the effusion method with radionuclides. Co was labeled by reactor irradiation and Ni and Fe were labelled by the introduction of radioisotopes. The temperature dependence of the vapor pressures was determined and compared with that obtained by other authors. The values of the sublimation heats were calculated from the curves obtained. (JSR)

30221 ELECTRON SPECTRUM AND PARTICULAR ABSORPTION OF HIGHLY-ALLOYED n-GaAs. Levkov, A. N.; Lomakin, G. G. (Ural State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 30-35(1975). (In Russian).

Results are presented of a numerical calculation by means of computer on a series of parameters and functional dependencies characterizing the electron spectrum of highly-alloyed semiconductors. Dispersion curves are theoretically calculated and obtained experimentally for the absorption coefficient in the region of interzonal transitions of highly-alloyed n-GaAs. The numerical method of calculation is based on the results of the studies of V. L. Bonch-Bruevich in which the Green function is used as a mathematical technique. Calculations and experimental measurements are presented for n-GaAs with a free-electron concentration of 4.8×10^{18} per cm^3 in the region of temperatures from 10 to 610°K. Agreement is observed between the theoretical and

experimental values of the absorption coefficient in the region of the absorption edge for photon energies exceeding the width of the forbidden zone of the pure semiconductor. (tr-auth)

30222 SOLUBILITY OF HYDROGEN AND DEUTERIUM IN TITANIUM AND ZIRCONIUM UNDER VERY LOW PRESSURE. Nagasaka, M.; Yamashina, T. (Hokkaido Univ., Sapporo). J. Less-Common Met.; 45: No. 1, 53-62(Feb 1976).

The solubilities of hydrogen and deuterium in α-titanium (500 to 800°C), β-titanium (900 to 1150°C) and α-zirconium (500 to 800°C) were determined in the pressure range 10^{-4} to 10^{-2} torr, using an UHV apparatus. The solubility data were observed to obey Sieverts' Law exactly. The isotope effect of hydrogen and deuterium on the solubility in the α-phase of titanium and zirconium could be explained by applying McLellan's model. The previous data on the solubility of hydrogen and deuterium in these metals under low pressure were comprehensively compared.

30223 X-RAY AND MOESSBAUER STUDIES OF THE PSEUDO-BINARY SYSTEM $Ce(Fe_{1-x}Ni_x)_2$. Harris, I. R. (Univ. of Birmingham, Eng.); Longworth, G. J. Less-Common Met.; 45: No. 1, 63-77(Feb 1976).

X-ray and ^{57}Fe Mössbauer measurements have been made on a series of alloys in the pseudo-binary system, $Ce(Fe_{1-x}Ni_x)_2$, x varying from 0 to 1.0. In the range x = 0 to x = 0.5, the variation of the room-temperature lattice spacing of the cubic Laves phase with increasing nickel content was similar to that observed in the system $Ce(Fe_{1-x}Co_x)_2$ with increasing cobalt content. Substantial positive deviations from the $Ce(Fe_{1-x}Co_x)_2$ curve were observed at higher values of x and these have been interpreted in terms of a decrease in the effective valency of the cerium atoms from the initial value of 4.0 ($4f^n$). The x-ray diffraction data and Mössbauer measurements indicated the presence of free iron in most of the ternary alloys, particularly in the middle of the composition range. The Curie points of the ferromagnetic alloys have been determined by differential thermal analysis (DTA) and these measurements, together with the Mössbauer studies, indicate the disappearance of magnetic order at $x \approx 0.36$. The variations of the ^{57}Fe isomer shift and the quadrupole splitting of the $Ce(Fe_{1-x}Ni_x)_2$ alloys with composition exhibit much larger changes than in the corresponding $Ce(Fe_{1-x}Co_x)_2$ system, and this has been attributed to changes in the density of states at the Fermi level and to changes in the effective valency of the cerium atoms with increasing nickel concentration.

30224 $Tb_2(Fe_{0.832}Al_{0.168})_{17}$: A SIMPLE CRYSTAL STRUCTURE. Boller, H. (Univ., Vienna); Oesterreicher, H. J. Less-Common Met.; 45: No. 1, 103-109(Feb 1976).

Annealed alloys of composition $Tb_{0.105}Fe_{0.745}Al_{0.15}$ crystallize in a hexagonal lattice with a = 8.532, c = 4.175 Å, c/a = 2.0436. The crystal structure is determined, and discussed in relation to similar structures derived from the $CaCu_5$ type.

30225 CRYSTAL STRUCTURE OF THE TERNARY R.E.Mo_2Al_4 PHASES (R.E. = Gd, Er, Yb). Fornasini, M. L.; Palenzona, A. (Univ., Genoa). J. Less-Common Met.; 45: No. 1, 137-141(Feb 1976).

The crystal structure of the ternary phase $YbMo_2Al_4$, space group I4/mmm, a = 6.717 and c = 5.312 Å, Z = 2, has been determined. $GdMo_2Al_4$ and $ErMo_2Al_4$ have been found to be isomorphous. The close structural relationship between these phases and the ternary MT_4Al_8 (M = Ce, Y; T = Cr, Mn, Fe, Cu), crystallizing in a superstructure of the $ThMn_{12}$ type, is pointed out.

30226 CRYSTALLOGRAPHIC AND MAGNETIC PROPERTIES OF R.E.$_2$(Fe,Ni)$_{17}$ ALLOYS. Steiner, W.; Planck, A.; Weihs, G. (Technische Hochschule, Vienna). J. Less-Common Met.; 45: No. 1, 143-153(Feb 1976).

Crystallographic and magnetic investigations on ternary alloys with the nominal composition R.E.$_2(Fe_{1-x}Ni_x)_{17}$, R.E. = Y, Dy, are reported. Solid solubility was found up to x = 0.5 and 0.3 for $Y_2(Fe,Ni)_{17}$ and $Dy_2(Fe,Ni)_{17}$, respectively. Single-phase samples could only be prepared by using an increasing excess of R.E. over the stoichiometric composition, with increasing Ni content. At higher Ni concentrations, an R.E.$(Fe,Ni)_5$ mixed crystal and α-Fe, or a γ-(Fe,Ni) alloy can be detected, depending on the nominal composition. The results of the magnetic measurements can be explained by means of a rigid-band model in analogy with the binary (Fe,Ni) alloys. The influence on the mean 3d moment of the conduction electrons contributed by the R.E. atoms is small in the mixed crystals with the Th_2Ni_{17}-type structure but strong for the binary R.E.$_2Ni_{17}$ compounds where a decrease of the Ni moment can be detected. The Curie temperatures increase with increasing x and show a maximum for $x \sim 0.4$ in the mixed crystals, $Y_2(Fe,Ni)_{17}$.

30227 INTERDIFFUSION OF NIOBIUM AND MOLYBDENUM. Vergasova, L. L. Tekhnol. Legk. Splavov; No. 4, 43-47(1974). (In Russian).

Values of the interdiffusion coefficient, D_{id}, and the activation energy, Q_{id}, of Nb and Mo were obtained in the range 1100 to 1500°C. Increase in Mo in Nb–Mo alloys decreases D_{id}; increase in temperature increases the diffusion mobility of atoms, and D_{id} is increased while retaining the composition dependence. There is little change in the relationship between Q_{id} and composition. Mo is the less mobile component and diffuses to a lesser depth than Nb. This occurs most clearly at annealing temperatures which are comparatively low for Mo, e.g., 1100°C. At this temperature D_{id} changes by an order with increase in Mo content. With increase in temperature of the diffusion anneal up to 1300°C, the change in D_{id} as a function of composition falls within one order which is reflected in the closeness of depths of interdiffusion of Nb and Mo. (Metals Abstr.)

30228 DENSITY OF INDIUM–BISMUTH ALLOYS. Otto, G. H. (Univ. of Alabama, Huntsville). J. Less-Common Met.; 45: No. 1, 163-171(Feb 1976).

The density of various In–Bi alloys at room temperature was measured by the buoyancy technique. With increasing Bi concentration in the alloys, the density increases smoothly between the values for the terminal elements indium and bismuth. No maxima occur at any of the compositions which correspond to the intermediate phases In_2Bi, In_5Bi_3 and InBi. On compound formation from the constituents, a volume contraction is observed which is proportional to the amount of bismuth in the alloy. For InBi, a maximum decrease in specific volume by 2.9 percent is found. However, despite the decrease in specific volume, the experimental density data for Bi concentrations up to 50 at. percent may be expressed in an additive manner by attributing a density of 10.27 g/cm^3 to the bismuth instead of the conventional value of 9.80 g/cm^3. This indicates that the bismuth acts in the alloys with a density it would have at room temperature in its supercooled liquid state.

30229 TERBIUM–IRON PHASE DIAGRAM. Dariel, M. P.; Holthuis, J. T.; Pickus, M. R. (Univ. of California, Berkeley). J. Less-Common Met.; 45: No. 1, 91-101(Feb 1976).

The terbium–iron phase diagram has been determined using metallographic, x-ray diffraction, differential thermal analysis, and electron microprobe techniques. The terminal solubilities of the two elements are extremely restricted, of the order of 0.1 at. percent for Tb in Fe. A eutectic reaction takes place at 28 at. percent Fe, 847°C. The four intermetallic compounds, $TbFe_2$, $TbFe_3$, Tb_6Fe_{23}, and Tb_2Fe_{17} melt non-congruently at 1187, 1212, 1276, and 1312°C, respectively. The Tb_2Fe_{17} compound appears in the rhombohedral Th_2Zn_{17} modification on the Tb-rich side and in the hexagonal Th_2Ni_{17} modification on the Fe-rich side of the stoichiometric composition.

30230 LOW-TEMPERATURE MAGNETIC STUDIES ON VARIOUS SUBSTITUTED RARE EARTH (R)–TRANSITION METAL (T) COMPOUNDS RT_5. Oesterreicher, H. (Univ. of California, San Diego); McNeely, D. J. Less-Common Met.; 45: No. 1, 111-116 (Feb 1976).

Materials with partial substitution of the Co in $SmCo_5$ by the elements Ni, Pt, Cu, Ag, Al, In, Si, and Sn, were prepared and their structures identified. In a similar vein, Sm substitution by Zr in $SmCo_5$ was investigated as was Al substitution for Co in $CeCo_5$. Furthermore, results on Al substitution for Co in RCo_5 compounds, with R equals Y, Gd, and Tb, are included. Stacking faults in the basal plane were observed in as-melted homogeneous compounds with Al and Si substitution for Co in $SmCo_5$. The magnetic properties of these materials, such as saturation moments and coercive forces, were investigated at 4.2°K. Al and Si substitution for Co in $SmCo_5$ results in outstanding coercive forces of the order of 30 to 50 kOe in powder and bulk materials. All other systems were disappointing in terms of magnetic hardness. The origin of outstanding magnetic hardness is discussed in terms of a model of the pinning of extremely energetic domain walls on obstacles of atomic dimension.

30231 CORRELATION BETWEEN CRITICAL TEMPERATURE AND OTHER ELECTRICAL PROPERTIES FOR THIN TANTALUM FILMS. Aguado Bombin, R.M.; Neal, W.E.J. (Physics Department, University of Aston, Birmingham B4 7ET, England). Appl. Phys. Lett. 28: No. 7, 410-410 (1 Apr 1976).

Measurements on thin tantalum films prepared by evaporation in ultrahigh vacuum show definite correlation between the critical temperature (T_c) and resistivity ratio (ρ_{300}/ρ_{10}). Empirical relationships are given for films having resistivity ratios in the range 1.2–6 corresponding to a thickness range 11·5–965 nm. (auth)

30232 THE CHARACTERIZATION OF SOME VANADIUM (100) SURFACE USING LEED AND AES. Szalkowski, F.J.;

Somorjai, G.A. (Inorganic Materials Research Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). J. Chem. Phys. 64: No. 7, 2985-2989 (1 Apr 1976).

Low energy electron diffraction (LEED) supplemented by Auger electron spectroscopy (AES) was used to investigate the properties of the (100) crystallographic face of vanadium metal. A (1×1) surface structure is characteristic of the clean metal surface. Sulfur segregates to the surface upon heating, forming first a $c(2\times2)$ structure and then a $(\sqrt{2}\times2\sqrt{3})R27°$ structure. A kinematical analysis of the diffracted beam intensity vs voltage curves proved appropriate for the $V(100)$–(1×1) structure and yields a value of −9.9 V for the inner potential and a value of 3.02 Å for the surface lattice constant. Room temperature gas adsorption studies on the $V(100)$–(1×1) surface indicate that oxygen diffuses into the lattice and produces a disordered surface, while carbon monoxide either does not absorb or is desorbed under the influence of the electron beam. (auth)

30233 THE ROLE OF GRAIN-BOUNDARY STRUCTURE IN SHOCK-INDUCED SPALLATION OF MOLYBDENUM. Murr, L.E. (Department of Metallurgical and Materials Engineering, New Mexico Institute of Mining and Technology, Socorro, New Mexico 87801). J. Appl. Phys. 47: No. 4, 1364-1369 (Apr 1976).

Grain boundaries and grain-boundary ledge structures are shown to have a controlling influence on intergranular spallation in molybdenum resulting from shock-wave rarefraction interactions. The structure of grain boundaries and their relationship to spall fracture are examined in detail utilizing the techniques of transmission and scanning electron microscopy, and are shown to be conducive to microcrack nucleation, coalescence, and propagation along the boundary planes. Grain boundaries possessing a high degree of complex structure such as dislocations and ledges are shown to vary significantly in effective dislocation density from the grain matrices, and this phenomenon coupled with the ability of ledges to nucleate cracks appears to account for intergranular spallation in molybdenum shock loaded to pressures of 150 and 250 kbar. (auth)

30234 FLUX PINNING IN BRONZE-PROCESSED Nb_3Sn. Luhman, T.; Pande, C.S.; Dew-Hughes, D. (Brookhaven National Laboratory, Upton, New York 11973). J. Appl. Phys. 47: No. 4, 1459-1463 (Apr 1976).

Superconducting critical currents have been measured at 4.2 K and applied magnetic fields up to H_{c2} for a series of solid-state processed-Nb_3Sn conductors. Variations were made in the alloy content of the matrix and core as well as heat-treatment times at 700 °C to produce a wide range of superconducting critical currents. The pinning-force density, F_p ($=J_c\times B$), plotted as a function of reduced field, h ($=H/H_{c2}$), exhibits a peak, F_p^{max}, at a reduced field h_p. F_p^{max} varies from 81×10^8 dyn/cm³ at $h_p=0.2$ to 18×10^8 dyn/cm³ at $h_p=0.32$. The high values of F_p^{max} for these samples are related to Nb_3Sn grain sizes which are 1000 Å or less. At 2 kG the flux-line lattice spacing is approximately 1000 Å or nearly one flux line per grain. Kramer has proposed a model to account for flux pinning in such hard type-II superconductors, and while the pinning-site density in the present samples is near the upper limit to which Kramer's model was meant to apply, it is possible to interpret the present data using his model. The dynamic pinning force $f_i(h)$ calculated by Kramer for flux-lattice shear around pinning sites too strong to be broken by the Lorentz force has the magnetic field dependence $h^{1/2}(1-h)^2$. In the high pinning-density limit where $\sqrt{\rho}=1/2a_0$, ρ being the pinning density and a_0 the flux-line lattice spacing, the magnetic field dependence of $f_i(h)$ must be changed to $h^{3/2}(1-h)^2/(h^{1/2}-n)^2$, where n equals $(\phi_0\rho/H_{c2})^{1/2}$, by incorporating the field dependence of a_0. Using this new field dependence enables a prediction of F_p^{max}, and associated h_p values, which fit the present data for bronze-processed Nb_3Sn. It is concluded that near the upper limit of pinning density to which the theory applies a sharp increase in F_p^{max} may occur without significant shifts in h_p to lower values. This result is added to the model's prediction for lower pinning-density materials, i.e., when lower values of F_p^{max} increase there is a shift in h_p to smaller values. (auth)

30235 TEMPERATURE-INDUCED MAGNETIZATION REVERSAL IN AN AMORPHOUS FERRIMAGNET. Venturini, E.L.; Richards, P.M. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 47: No. 4, 1632-1638 (Apr 1976).

Both temperature- and magnetic-field-induced magnetization reversals have been studied near the compensation temperature T_{comp} in rf-sputtered amorphous Gd-Co thin films using a vibrating sample magnetometer. The net magnetization in these films goes smoothly through zero at $T=T_{comp}$ and can be switched through 180° from a metastable state opposite to the applied magnetic field direction to a stable state parallel to the field by varying either the temperature or the field strength. If the reversal occurs through a uniform rotation of the magnetization, a simple two-magnetic-sublattice model allows an effective anisotropy energy K_{eff} to be determined from the switching data. K_{eff} exhibits the same anomalous decrease near T_{comp} as previously reported using magnetic resonance and static magnetization data. (auth)

30236 A COMPARATIVE STUDY OF THE HYPERFINE FIELDS IN FERROMAGNETIC GdRh AND GdZn. Dormann, E. (Experimentalphysik II, Technische Hochschule Darmstadt, D-61 Darmstadt, Germany); Buschow, K.H.J. J. Appl. Phys. 47: No. 4, 1662-1667 (Apr 1976).

The zero-field nuclear resonance of Gd^{155}, Gd^{157}, Rh^{103}, and La^{139} were studied in $Gd_{1-x}La_xRh$. Magnetic measurements performed on GdRh show that this compound has a Curie temperature of 24 K and a magnetization corresponding to $6.6\mu_B$/Gd at 4.2 K. These values are low compared with those of GdZn (270 K; $7.5\mu_B$/Gd). The NMR results of $Gd_{1-x}La_xRh$ are compared with similar data available for $Gd_{1-x}La_xZn$. For both series the hyperfine field at the Gd site is separated into its different contributions. The transferred hyperfine field at the Gd site is positive in GdRh but negative in GdZn. It is suggested that the exchange interaction between the $4f$ moments in GdZn proceeds predominantly via d-electron polarization, whereas the RKKY-type interaction, mediated by s electrons, is relatively weak. (auth)

30237 PARAMAGNETIC RESONANCE OF Gd IN Lu SINGLE CRYSTALS. Baberschke, K.; Nagel, J. (Fachbereich Physik, Freie Universität Berlin-West Berlin, West Germany). Phys. Rev. B 13: No. 7, 2793-2797 (1 Apr 1976).

The spin resonance of dilute Gd in Lu single crystals has been measured. It shows a single-line spectrum. The field for resonance, as well as the linewidth, change as a function of crystal orientation. The experimental results are concentration independent (unbottlenecked) and can be described by $g=2.10(1)$, a thermal broadening of the linewidth $b=80(8)$ G/K and an axial crystal field parameter $D=-63(6)$ G. The results are compared with those in Y and Sc. (auth)

30238 FILM STRUCTURE AND ENHANCED SUPERCONDUCTIVITY IN EVAPORATED ALUMINUM FILMS. Pettit, R.B. (Sandia Laboratories, Albuquerque, New Mexico 87115); Silcox, J. Phys. Rev. B 13: No. 7, 2865-2872 (1 Apr 1976).

The increase in the superconducting transition temperature of evaporated aluminum films is correlated with the following structural properties of the films: the average grain size, the average lattice constant, the film thickness, and the presence or absence of a thin oxide layer surrounding each grain in the film. It is found that for all the films studied, the transition temperature T_c is a function only of the average grain size a with $\ln(T_c)\propto a^{-0.82}$. This approximate $1/a$ dependence is in agreement with several theories which indicate that the increased transition temperatures result from changes in the phonon spectrum at the surface of small grains. Even though we have determined that there is a thin oxide layer surrounding each grain in several films, an electron-exciton-electron enhancement mechanism that has been proposed is not observed. However, the presence of the oxide may influence the magnitude of the enhancement. (auth)

30239 SURFACE EFFECTS AT THE SUPERCONDUCTING PHASE TRANSITION IN TANTALUM AND NIOBIUM. Varmazis, C.; Imry, Y.; Strongin, M. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. B 13: No. 7, 2880-2886 (1 Apr 1976).

A sharp diamagnetic drop is observed in the 14-MHz transition of niobium and tantalum very close to T_c, in small parallel dc magnetic fields. The drop occurs in the regime where $\lambda>\delta_n$ and occurs over a temperature interval that is smaller than the one corresponding to the BCS dependence of λ with temperature. Because of the sharpness of the drop it is analyzed in terms of an increased conductivity in the normal state very close to T_c due to enhanced fluctuations of superconducting regions at the surface. The possible role of these fluctuations for the nucleation of the superconducting state is discussed. (auth)

30240 ASPHERICITY IN THE MAGNETIZATION DISTRIBUTION OF HOLMIUM. Felcher, G.P.; Lander, G.H.; Arai, T. (Argonne National Laboratory, Argonne, Illinois 60439); Sinha, S.K.; Spedding, F.H. Phys. Rev. B 13: No. 7, 3034-3045 (1 Apr 1976).

In a spiral magnetic structure an aspherical magnetic moment distribution around the ions gives rise to a new set of diffraction lines indexed as third-order satellites. Neutron-diffraction measurements have been made on single crystals of holmium and a $Ho_{0.9}Sc_{0.1}$ alloy to determine the magnetic structures as a function of temperature, and measure the intensities of the third-order satellites. From these intensities the experimental asphericity of the magnetization density is compared to that calculated with a single-ion model. The agreement between theory and experiment is qualitative; the experimental intensities being larger by a factor of ~1.5. The temperature dependence of the third-order satellite is in good agreement with a simple model proposing exchange splitting of the free-ion multiplet, with a negligible crystal-field interaction. (auth)

30241 MAGNETIC-SUSCEPTIBILITY MEASUREMENTS OF A PRASEODYMIUM KONDO SYSTEM: $La_{1-x}Pr_xSn_3$. Lethuillier, P. (Laboratoire de Magnétisme, Centre National de la Recherche Scientifique, 38042 Grenoble Cédex, France); Chaussy, J. Phys. Rev. B 13: No. 7, 3132-3134 (1 Apr 1976).

The magnetic susceptibility of $La_{1-x}Pr_xSn_3$ compounds ($x = 1.0,0.7,0.4,0.2,0.1,0.05,0.01,0.0$) has been measured between 2 and 300 K and the heat capacity of $PrSn_3$ and $LaSn_3$ between 20 and 300 K. It is shown that the magnetic susceptibility is anomalously reduced by the interaction with the conduction band showing the delocalization of the 4*f* shell of praseodymium. (auth)

30242 SPIN WAVES IN THE CUBIC FERRIMAGNET $Ho_{0.88}Tb_{0.12}Fe_2$. Nicklow, R.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Koon, N.C.; Williams, C.M.; Milstein, J.B. Phys. Rev. Lett. 36: No. 10, 532-535 (8 Mar 1976).

Using neutron spectrometry we have investigated the magnon dispersion relation for the ferrimagnetic cubic Laves compound $Ho_{0.88}Tb_{0.12}$ Fe_2 at room temperature and 12 K. The results are described surprisingly well by a very simple near-neighbor exchange model which includes only iron-iron and iron-rare-earth interactions, crystal field anisotropy, and temperature renormalization that is derived from the sublattice magnetization. (auth)

30243 SPIN POLARIZATION IN LOW-ENERGY ELECTRON DIFFRACTION FROM W(001). Feder, R. (Institut für Festkörperforschung der Kernforschungsanlage Jülich, 517 Jülich, Germany). Phys. Rev. Lett. 36: No. 11, 598-600 (15 Mar 1976).

A relativistic low-energy electron-diffraction theory has been modified to allow computations for energies up to 200 eV. Its application to W(001) yields intensity profiles in reasonable correspondence with experiment, and pronounced polarization profiles which show encouraging agreement with novel and as yet limited experimental data. A high sensitivity of the polarization profiles to displacement of the topmost layer suggests that spin polarization measurements could be valuable for structure determination of surfaces involving heavy atoms. (auth)

30244 CRYSTAL-ELECTRIC-FIELD EFFECTS ON THE THERMAL EXPANSION OF TmSb. Ott, H.R. (Laboratorium für Festkörperphysik, Eidgenössische Technische Hochschule, 8049 Zürich, Switzerland); Lüthi, B. Phys. Rev. Lett. 36: No. 11, 600-602 (15 Mar 1976).

We report a crystal-electric-field effect on the low-temperature thermal expansion of TmSb, manifesting itself as a Schottky-type anomaly. From our results we deduce a volume dependence of the crystal-field level splitting which is in contradiction to point-charge-model expectations. (auth)

30245 DOES STRONG-COUPLING THEORY DESCRIBE SUPERCONDUCTING NB? Bostock, J.; Diadiuk, V.; Cheung, W.N.; Lo, K.H.; Rose, R.M.; MacVicar, M.L.A. (Center for Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. Lett. 36: No. 11, 603-606 (15 Mar 1976).

The electron-coupled phonon spectrum α^2F, λ, and μ^* have been determined for polycrystalline and high-purity, single-crystal niobium from tunnel junctions fabricated with three different counterelectrodes. All spectra compare well with phonon spectra extracted from neutron-scattering experiments. Values of λ are BCS-like and μ^* is always negative. Computer-modeling studies describing a niobiumlike material cannot generate an acceptable set of strong-coupling parameters. (auth)

30246 MAGNETOELASTIC EXCITATIONS IN SINGLE-CRYSTAL GADOLINIUM. O'Donnell, M.; Wang, J.T.; Blackstead, H.A. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. Lett. 36: No. 11, 606-609 (15 Mar 1976).

We show that parallel static and rf magnetic fields applied in the basal plane of single-crystal gadolinium samples excite phonons having a frequency equal to that of the rf field. These results, including measurements of the phonon signal as a function of angle between the rf and dc fields and as a function of the power input to the cavity, are shown to be inconsistent with current magnetoelastic theory. (auth)

30247 THEORY OF ION ANGULAR DISTRIBUTIONS IN ELECTRON-STIMULATED DESORPTION. Gersten, J.I.; Janow, R.; Tzoar, N. (Department of Physics, City College of the City University of New York, New York, New York 10031). Phys. Rev. Lett. 36: No. 11, 610-613 (15 Mar 1976).

The angular distribution of ions desorbing from the surface of a solid is studied theoretically. Specific calculations for oxygen adsorbed on the (100) face of tungsten are presented. The angular patterns result from the three-dimensional spatial variations in the ion-solid potential surface. Details of the pattern are found to vary sensitively with changes in the surface geometry. (auth)

30248 PREDICTION OF STRONG BONDING EFFECTS AND AN ANOMALOUS FORM FACTOR IN Sc METAL. Gupta, R.P. (Magnetic Theory Group, Department of Physics, Northwestern University, Evanston, Illinois 60201); Freeman, A.J. Phys. Rev. Lett. 36: No. 11, 613-616 (15 Mar 1976).

Field-induced magnetization densities of Sc metal determined from augmented plane-wave functions, including local density-of-states effects, were found to show a large spatial expansion of the 3*d* density and strong bonding effects. These result in an "anomalous" behavior of the neutron magnetic form factor which has been found in the experiments of Koehler and Moon. (auth)

30249 FIELD-INDUCED PARAMAGNETIC FORM FACTOR IN METALLIC SCANDIUM. Koehler, W.C.; Moon, R.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. Lett. 36: No. 11, 616-619 (15 Mar 1976).

The magnetic form factor of metallic scandium has been measured at a temperature of 100 K in an applied field of 57.2 kOe by the polarized-neutron technique. Contrary to results on other 3*d* metals, the form factor is significantly different from that for the 3*d* electron in the free atom. Our results agree rather well with those of a calculation by Gupta and Freeman based on APW wave functions. (auth)

30250 NEW EVAPORATION METHOD OF HIGH-MELTING-TEMPERATURE MATERIALS UTILIZING A VACUUM DISCHARGE. Igarashi, Y.; Kanayama, M. (Department of Applied Science, Tohoku University, Sendai, 980, Japan). Appl. Phys. Lett. 28: No. 9, 481-482 (1 May 1976).

By utilizing a discharge caused between electrodes (specimens) in a high vacuum ($\simeq 2\times10^{-5}$ Torr) and without inert gas, the evaporation of high-melting-temperature materials (W, Ta, and C) has been successfully achieved. The main part of the instrument was composed of two electrodes (0.8–1.5 mmϕ) and a helical filament (0.8–1 mmϕ, 10 turns). An alternating voltage was supplied between electrodes (sparking gap: 0.5–2 mm), and in order to get sparking easily, the electrodes were preheated by bombarding with electrons (emission: 500 μA) from the filament. After starting, the high voltage was lowered to a range of 1–2 kV and the filament fell in disuse. Then the discharge was maintained stably. The structure of 600-Å-thick W films deposited by this method was mostly of the ordered W_3W. (auth)

30251 CHEMICAL BONDING AND HIGH T_c IN "Nb_3Ge" SPUTTERED FILMS. Rogowski, D.A.; Roy, R. (Materials Research Laboratory, Pennsylvania State University, University Park, Pennsylvania 16802). Appl. Phys. Lett. 28: No. 9, 557-559 (1 May 1976).

Soft x-ray *L*-emission spectra for Nb and Ge in a series of single-phase "Nb_3Ge" sputtered films of known composition have been obtained. Correlations are shown to exist between T_c and the nature of the bonding as evidenced by shifts in the emission peaks of characteristic x rays. The Nb and Ge *L*-emission peaks shift toward lower energies with decreasing lattice parameter and Nb/Ge ratio (and increasing T_c). (auth)

30252 4*f* EXCITATION ENERGIES IN RARE-EARTH METALS: RELATIVISTIC CALCULATIONS. Herbst, J.F. (National Bureau of Standards, Washington, D. C. 20234); Watson, R.E.; Wilkins, J.W. Phys. Rev. B 13: No. 4, 1439-1445 (15 Feb 1976).

We describe calculations of 4*f* electron binding energies for the rare-earth metals. Relativistic Hartree-Fock calculations for atomic configurations most closely approximating those of the metals are initially performed, and crystal potentials are constructed by means of the renormalized-atom method. Relativistic band calculations are iterated to crude self-consistency and total band energies obtained. Correlation effects identical to those in the free atoms are assumed. Within the assumption of a completely screened final state, in which the atomic site having the 4*f* hole is electrically neutral, 4*f* binding energies are estimated which are in at least as good agreement with experiment as previous, less complete calculations. The impact of the complete screening approximation is assessed by estimating the binding energies corresponding to atomic sites which are ionized in their final states; we find that the presence of an additional screening electron lowers the 4*f* binding energy by 4–6 eV. (auth)

30253 ALLOY THEORY OF THE INTERMEDIATE VALENCE STATE: APPLICATION TO EUROPIUM METAL. Rosengren, A. (Institute of Theoretical Physics, University of Stockholm, S-113 46 Stockholm, Sweden); Johansson, B. Phys. Rev. B 13: No. 4, 1468-1472 (15 Feb 1976).

A microscopic theory for the intermediate valence state is given, containing no phenomenological parameters. The intermediate state is considered as an alloy of constituents of different integral valence and treated in the virtual-crystal approximation. The theory is applied to europium metal, resulting in a continuous change of valence, starting at 180 kbar and being completed at 350 kbar. The calculated pressured-volume relation resembles those found for some rare-earth monochalcogenides. (auth)

30254 QUASIPARTICLE INTERACTIONS IN THE OPTICAL PROPERTIES OF Nb AND Mo. Pickett, W.E.; Allen, P.B. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. B 13: No. 4, 1473-1476 (15 Feb 1976).

The optical masses of Nb and Mo are calculated within one-electron theory and are found to disagree with the reported experimental values. Large Fermi-liquid effects provide a probable resolution of the discrepancy. The effects of quasiparticle interactions and low-energy interband transitions on the optical properties are discussed and further experiments are suggested. (auth)

30255 MAGNETIZATION REVERSAL IN $GdCo_5$ SINGLE CRYSTALS. Katayama, T. (Electrotechnical Laboratory, Tanashi, Tokyo 188, Japan); Ohkoshi, M.; Koizumi, Y.; Shibata, T.; Tsushima, T. Appl. Phys. Lett. 28: No. 10, 635-637 (15 May 1976).

The magnetic properties and the process of magnetization reversal in a bulk single-crystal sphere of $GdCo_5$ were studied between 80 and 300 K. Numerous rectangular hysteresis loops were observed similar to observations made in small-particle experiments, and they are discussed in terms of the nucleation model and the pinning model. (auth)

30256 NASA LEWIS RESEARCH CENTER'S MATERIALS AND STRUCTURES DIVISION. Weymueller, C. R. Met. Prog.; 109: 56-61(Mar 1976).

Research activities at the NASA Lewis Research Center on materials and structures are discussed. Programs are noted on powder metallurgy superalloys, eutectic alloys, dispersion strengthened alloys and composite materials. Discussions are included on materials applications, coatings, fracture mechanics, and fatigue. (JRD)

30257 EQUIPMENT FOR DIFFERENTIAL THERMAL ANALYSIS AND STUDY OF PHASE DIAGRAM OF InSb-CdTe SYSTEM. Morozov, V. N.; Karnaukhova, E. N.; Skorobogatova, L. A.; Ryazantsev, A. A. (Irkutskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Prikladnoj Fiziki). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 9, 52-56(Jul 1974). (In Russian)

From 5th all-union conference for thermal analysis; Novosibirsk (3 Jul 1973). For English translation see the journal Sib. Chem. J.

A simple piece of equipment is proposed for differential thermal analysis (DTA) which is based on electronic potentiometer EPP-09 and a semiautomatic potentiometer P 2/I, by means of which it is possible to record thermal effects with sufficient accuracy at a low sensitivity to mechanical disturbances. The phase diagram of the InSb-CdTe system was investigated by the DTA method. The system is a simple eutectic type. The eutectic point occurs at a composition of 6 ± 1 mol% CdTe at a temperature of 510 ± 1°C. Experimental determinations of the heats of fusion were carried for InSb and CdTe, which were found to be respectively 10.7 ± 0.9 and 9.5 ± 0.9 kcal/mol. A calculation was made of the energy of mixing in the liquid phase along the liquidus line. It was shown that near the crystallization temperature of alloys, which correspond to compositions of 70 to 80 mol% CdTe, a strong interaction is observed between components of the system. (tr-SJR)

30258 THERMODYNAMICS OF NICKEL-MOLYBDENUM ALLOYS. Meshkov, L. L.; Guzei, L. S.; Sokolovskaya, E. M. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 8, 1128-1129(Aug 1975).

Translated from Zh. Fiz. Khim.; 49: No. 8, 1917-1920(Aug 1975).

The nickel-molybdenum system was investigated in cells containing a solid oxide electrolyte with a separate gas compartment. From the emf and its temperature dependence were calculated the thermodynamic activities of nickel and molybdenum at 1273 and 1123°K and the partial thermodynamic functions of formation of the alloys. (auth)

Radiation Effects

Refer also to abstracts 28436, 29447, 31004, and 32433.

30259 (IAEA-171, pp 67-118) RADIATION DAMAGE IN METALS. Hemmerich, J. 1975.

From panel meeting on the utilization of low energy accelerators; Zagreb, Yugoslavia (30 Sep 1974).

In utilization of low energy accelerators. (International Atomic Energy Agency, Vienna (Austria)).

An introduction to the important topics of radiation damage is given, and the basic principles of damage production are briefly discussed (energy transfer between fast particles and target atoms, single and multiple displacements). The present understanding of defect recovery by thermal activation is summarized: annealing of close Frenkel pairs, free migration of interstitials, interstitial trapping and clustering reactions, and vacancy migration. Recent experimental results revealing the structure and dynamical behavior of the single interstitial atom in fcc metals are presented: measurements of diffuse x-ray scattering and mechanical and magnetical relaxation phenomena give conclusive evidence that the interstitial is present in the ⟨100⟩-split configuration and its dynamical behavior can very satisfactorily be explained by recently detected low frequency resonant modes. (auth)

30260 (SAND-76-8618) IN-SITU OBSERVATIONS OF ION IMPLANTED SURFACES. Thomas, G. J.; Bauer, W. (Sandia Labs., Livermore, Calif. (USA)). Feb 1976. Contract AT(29-1)-789. 19p. (CONF-760209-22). Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

A scanning electron microscope facility is described which enables direct observations of sample surfaces during implantation. This technique enables measurements of the growth rates of surface features caused by He implantation of metals. Results from 300 keV He^+ implantation of Ti samples indicate that exfoliation or flaking of the sample surface is a distinctly different process from blistering and proceeds at radically different rates. In addition, it was observed that exfoliation could be significantly reduced by cold-working.

30261 (TRG-Report-2680(S), pp 5-7) VOID FORMATION IN IRRADIATED TANTALUM. Manley, A. J. (UKAEA Reactor Group, Dounreay). Sep 1975.

From 22nd UKAEA diffraction analysis conference; Dounreay, United Kingdom of Great Britain and Northern Ireland (UK) (15 Oct 1974).

In role of diffraction and electron analysis in the fast reactor programme. (UKAEA Reactor Group, Springfields).

The initial swelling rate for tantalum is ≈1% per 1 dpa in the range 500-540°C. As $T_m 4$ for tantalum is ≈540°C, it is apparent that at irradiation temperatures ≈500°C, variations in temperature will significantly affect the swelling. At ≈470°C the swelling is greatly reduced. (auth)

30262 (TRG-Report-2680(S), pp 7-8) VOIDS IN FUEL PIN CLADDING. Bramman, J. I.; Brown, C.; Cawthorne, C.; Fulton, E. J.; Linekar, G. A. B.; Sharpe, R. M. (UKAEA Reactor Group, Dounreay). Sep 1975.

From 22nd UKAEA diffraction analysis conference; Dounreay, United Kingdom of Great Britain and Northern Ireland (UK) (15 Oct 1974).

In role of diffraction and electron analysis in the fast breeder programme. (UKAEA Reactor Group, Springfields).

Immersion density measurements and electron microscopy examinations were used to give quantitative information on volume changes, void concentrations and distributions, dislocation densities, and inhomogeneity swelling. Effect of low-dose neutron irradiation on unstressed, solution-treated 316 stainless steel is described. (DLC)

30263 INFLUENCE OF LATTICE DEFECTS ON THE WEAR OF IRON. Szatzschneider, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Lab. fuer Isotopentechnik). Materialpruefung; 17: No. 11, 393-395(Nov 1975). (In German)

Wear tests were conducted on iron specimens with identical hardnesses generated by different techniques such as thermal treatment, cold working, and neutron irradiation. Following this treatment the specimens differed from each other by their lattice defects. The test results revealed generally lower wear rates for irradiated specimens as compared with unirradiated specimens. This demonstrated that the description of wear by means of material hardness alone is very incomplete and that the type of structural defects has to be considered. (DE)

30264 ION BOMBARDMENT AND IMPLANTATION. Dearnaley, G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 167-214 of Surface Science. Volume II. Vienna; International Atomic Energy Agency (1975).

From international meeting on surface science; Trieste, Italy (16 Jan 1974). See STI/PUB-396(Vol. 2); CONF-740139-P2.

The processes of ion implantation and bombardment are discussed as ways of both altering and measuring the composition and structure of solid surfaces. Practical applications of this subject are described, as well as the physical mechanisms involved in atomic collision phenomena in solids. 58 references, 28 figures (auth)

30265 TEMPERATURE DEPENDENCE OF IRRADIATION DAMAGE IN ZIRCONIUM ALLOYS. Ells, C. E.; Coleman, C. E.; Williams, C. D. (Chalk River Nuclear Labs., Ont.). pp 77-89 of Mechanical Behavior of Materials. Volume II. Kyoto; Society of Materials Science, Japan (1974).

From symposium on mechanical behavior of materials; Kyoto, Japan (21 Aug 1974). See CONF-740847-P2.

Several zirconium alloys, ranging in composition from crystal bar zirconium to alloys based on sponge zirconium containing Sn, Mo, Nb, and Al, have been irradiated at temperatures up to 875°K and tensile tested after irradiation. When the irradiation temperature is ≲ 675°K, irradiation hardening is always observed, inde-

pendent of alloy composition and metallurgical condition. At irradiation temperatures $\lesssim$ 675°K softening can occur during irradiation, through annealing or averaging of cold worked and quenched materials respectively. Irradiation hardening at temperatures > 725°K may be dependent on neutron flux or fluence but this point is still controversial. Irradiation damage defects are still present in the alloys at irradiation temperatures > 725°K, but these defects are larger and less numerous than those formed at lower temperatures. (auth)

30266 INVESTIGATIONS OF NEUTRON IRRADIATED IRON BY POSITRON ANNIHILATION AND CORRELATED INTERNAL FRICTION MEASUREMENTS. Weller, M. (Max-Planck-Institut fuer Metallforschung, Stuttgart); Diehl, J.; Triftshaeuser, W. Solid State Commun.; 17: No. 10, 1223-1226(15 Nov 1975).

Positron annihilation experiments have been performed on iron after low temperature neutron irradiation and during isochronal annealing. A good correlation exists between internal friction and positron annihilation data for iron with interstitial impurities, proving that these impurities react with vacancies during annealing (complex-formation). (auth)

30267 UNUSUAL SECONDARY DEFECT DISTRIBUTIONS IN QUENCHED GOLD. Westmacott, K. H. (Michelson Lab, China Lake, Calif). J. Appl. Phys.; 45: No. 11, 5079-5081 (Nov 1974).

Unusual secondary defect structures consisting of high concentrations of stacking-fault tetrahedra precipitated in shells around large voids were found in oxygen-annealed and quenched high-purity gold. The observations are explained in terms of impurity segregation during growth of the void followed by heterogeneous nucleation of tetrahedra on the impurities. A strong impurity/vacancy binding energy is suggested by the magnitude of the impurity enrichment around the voids, and the apparent effectiveness of the impurities in nucleating tetrahedra. These results are pertinent to understanding the formation and growth of voids in materials irradiated to high neutron fluences in the core of fast reactors. (14 references)

30268 PHASE TRANSFORMATIONS AT BOMBARDMENT OF THIN FILMS WITH IONS. Bykov, V. N. (Inst. of Physics and Power Engineering, Obninsk); Troyan, V. A.; Zdorovtseva, G. G.; Khaimovich, V. S. Phys. Status Solidi (a); 32: No. 1, 53-61(16 Nov 1975).

Phase transformation occurs in thin films of metals after bombardment with He^+, N^+, and Ar^+ ions at an energy of 30 keV in the dose range of 10^{15} up to 10^{18} ions/cm^2. The transformation of bcc to fcc to hcp takes place in Fe and Mo films; fcc to hcp in Ni films; hcp to fcc in Ti films. The results are explained considering the storage of radiation defects when bombarding with ions of medium energy. (auth)

30269 HALL EFFECT AND SHEET RESISTIVITY MEASUREMENTS ON ION-BOMBARDED InSb. Wiedeburg, K. H.; Betz, H.; Kranz, H. (Institut fuer Festkoerpertechnologie der Fraunhofer Gesellschaft, Munich). Phys. Status Solidi (a); 31: No. 1, K69-K71(16 Sep 1975).

To study the effects of radiation damage in InSb, samples were bombarded by argon ions at 150 keV in order to produce a damage profile similar to that of sulfur ions. Noble gases are supposed to be electrically inactive after implantation and annealing. The results of Hall measurements after argon bombardment are shown for comparison with those of sulfur implanted samples. It is found that the annealing behavior of S implanted samples is similar to those bombarded by argon. This indicates that radiation damage is responsible for the conductivity. Conductivity of n-type is obtained only after annealing at temperatures between 270 and 350°C, i.e. the damage anneals at 350 to 400°C. The electron mobility in the n-type layers does not exceed 10,000 cm^2/Vs thus indicating incomplete restoration of the lattice after annealing. Bombardment with argon causes about as much electrically active defects as implantation of sulfur. Measurements of samples implanted with S at 80 keV show similar annealing behavior as those implanted at 150 keV. At each energy under investigation the number of electrically active defects is less than proportional to the dose. A dependence of the production of defects on energy is not obvious. (auth)

30270 DOSE RATE EFFECTS IN NICKEL-ION-IRRADIATED NICKEL. Westmoreland, J. E.; Sprague, J. A.; Smidt, F. A.; Malmberg, P. R. (Naval Research Lab., Washington, DC). Radiat. Eff.; 26: No. 1-2, 1-16(Sep 1975).

Nickel samples have been irradiated at two different dose rates with the same dose of 2.8-MeV $^{58}Ni^+$ to a peak damage level of 13 dpa. The peak damage dose rates were $\sim 7 \times 10^{-2}$ dpa s^{-1} (HDR) and $\sim 7 \times 10^{-4}$ dpa s^{-1} (LDR). An upward shift of ~75°C in the low-temperature limit for swelling has been observed for this increase of a factor of 100 in dose rate. The HDR results showed a peak swelling of 1.2% at 625°C, while the LDR results gave a peak swelling of 2.4% at 550°C. The LDR samples contained larger voids at lower densities than the HDR samples at all temperatures at which voids were observed. The results were compared with models for void nucleation and growth from which it was concluded that the HDR and LDR swelling curves both exhibited a low temperature regime which was void-growth-limited and a high temperature regime which was void-nucleation-limited. When temperature independent void and dislocation parameters were employed, the Brailsford and Bullough (BB) void growth model predicted that both LDR and HDR swelling would extend to much higher temperatures than was observed. When the experimentally measured parameters were employed at each point, the temperature dependence of the calculated swelling rate and that of the observed swelling agreed well for the LDR data but the resulting curves differed by ~50°C for the HDR results. Thus, the BB theory has little quantitative predictive capacity because at present the temperature and dose rate variations of the void and dislocation parameters must be determined experimentally and even the use of these data does not necessarily give quantitative agreement. The various BB temperature shift models similarly lack quantitative predictive value since similar void and dislocation parameters enter these expressions. (auth)

30271 LOW TEMPERATURE ELECTRON IRRADIATION OF α-BRASS: DEFECT ANNEALING AND ASSIGNMENT. Damask, A. C. (Queens Coll., New York); Gilbert, J.; Herman, H. Radiat. Eff.; 26: No. 1-2, 89-94(Sep 1975).

α-CuZn (30%) was irradiated at 20°K by 1 MeV and 1.5 MeV electrons and isochronally annealed. Following 1 MeV irradiation two electrical resistivity annealing steps were observed, one centered at 100°K with energy of 0.25 ± 0.05 eV and one centered at 255°K with an energy of 0.8 to 0.9 eV. The 100°K step does not go below the pre-irradiated value while the 255°K step does and they are assigned as Cu interstitials and vacancies, respectively. Following 1.5 MeV irradiation, the above two steps appear and, in addition two other steps, a small step at 75°K and a broad step from 120 to 210°K which falls below the pre-irradiated value. These steps are assigned to Zn interstitials. These annealing stages are discussed in relation to those of pure Cu and the evidence indicates that the interpretation of Stage III of pure Cu as an interstitial-type defect cannot satisfy the observations on α-CuZn. Since a different type of explanation is required for α-CuZn such an explanation may be applicable to pure Cu also. The large decrease in electrical resistivity which occurs in the 255°K annealing stage indicates that α-brass can be fully ordered by appropriate irradiation technique and that the critical temperature lies in the range of 240 to 250°K. (auth)

30272 RECOVERY KINETICS IN STAGES I_D AND I_E OF IRRADIATED METALS: ONE-DIMENSIONAL VERSUS THREE-DIMENSIONAL INTERSTITIAL MIGRATION. Goesele, U.; Frank, W. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Radiat. Eff.; 26: No. 1-2, 79-87(Sep 1975).

It is shown that at early times t the rate dc/dt of a diffusion-controlled bimolecular reaction A + B → C obeys the relationship $dc/dt = -\sqrt{D/\pi t}\, c_0 g(r_0)$ provided that the probability $g(r_0)$ to find at t = 0 particles A and B at the distance of reaction, r_0, is finite (D = sum of the diffusivities of A and B, c = atomic fraction of A or B, c_0 = value of c at t = 0). Since this result is independent of whether the particles diffuse in one or three dimensions, the observation that the early portion of the recovery stage I_D of electron-irradiated copper follows this law cannot be exploited to discriminate between the migration of crowdions or three-dimensionally diffusing interstitials. Computer simulations show that a separation of uncorrelated recovery (Stage I_E) from correlated recovery (Stage I_D) occurs not only for interstitial migration in three dimensions but also for the migration of a mixture of off-line and on-line crowdions. Hence, a discrimination between the current models of radiation damage in metals based on an analysis of the recovery kinetics in the Stage I_D/I_E regime appears hardly feasible. (auth)

30273 STRAIN AMPLITUDE-DEPENDENT EFFECTS IN ELECTRON IRRADIATED NIOBIUM. Seiffert, S. L.; Vanoni, F. (CEN, Grenoble, France). Scr. Metall.; 10: No. 1, 67-73(Jan 1976).

Results are presented of a preliminary study of strain amplitude-dependent damping effects in 2-MeV electron-irradiated high-purity, polycrystalline niobium. Damping behavior was initially examined before and after irradiation at low temperature (18°K), and following an isochronal anneal in steps for temperatures through resistivity recovery Stage 1 to 35°K. (DLC)

30274 SPATIAL DEPENDENCE OF VOID GROWTH RATES IN THE IRRADIATION OF THIN FOILS: THEORY AND CALCULATIONS. Guthrie, G. L.; Straalsund, J. L. (Westinghouse

Hanford Co., Richland, WA). Scr. Metall.; 9: No. 11, 1149-1152 (Nov 1975).

Results are presented of studies on the steady state spatial distribution of D/sub v/C/sub v/–D/sub I/C/sub I/ near the boundary of thin foils during irradiation, where the D's are diffusivities, the C's are point defects, and the subscripts refer to vacancies and interstitials. It was found that the effects of the surface condition on void nucleation and growth can be assessed properly only by including biased sinks and considering the spatial dependence of D/sub v/C/sub v/–D/sub I/C/sub I/. This results in a deeper surface effect, and a different dependence on generation rate, temperature, and microstructure. (JRD)

30275 EFFECT OF B, C, N, AND Ne ION IMPLANTATION ON THE OXIDATION OF POLYCRYSTALLINE Cu. Naguib, H.M.; Kriegler, R.J. (Bell-Northern Research, Ottawa, Ontario, Canada); Davies, J.A.; Mitchell, J.B. J. Vac. Sci. Technol. 13: No. 1, 396-400 (Jan 1976).

B, C, N, and Ne ions of doses between 10^{15}–10^{17} ions/cm^2 were implanted to a depth of approximately 700 Å into polycrystalline Cu. The amount of oxygen incorporated during subsequent oxidation of the samples at 200 °C was determined from the interference color of the oxides and from nuclear microanalysis using the $^{16}O(d,p)^{17}O$ reaction. Implantation of B or Ne reduces the subsequent oxidation. On the other hand, C implantation enhances the oxidation, except in the initial stages where a slight reduction is observed. Implantation of N ions is more complex; the resulting oxidation enhanced at low doses but is reduced at higher doses. The results are interpreted in terms of a combination of chemical and damage effects induced by the implanted ions. (auth)

30276 ELECTRON-ENERGY-LOSS EXPERIMENTS ON CALCIUM, STRONTIUM, AND BARIUM. Langkowski, J. (Univ., Hamburg). J. Phys., D (London); 8: No. 17, 2058-2064(1 Dec 1975).

Electron-energy-loss experiments on thin films of Ca, Sr, and Ba performed with 50 keV electrons are reported. The energy loss function is derived from the spectra and further the dielectric functions of these metals are determined in the energy range of 2 to 50 eV. The dispersion of the losses as well as the dependence of its half-widths on the wave-vector has been determined. These results are compared with those of others. (auth)

30277 COMPUTER SIMULATION OF THE FORMATION AND ANNEALING OF DEFECTS IN REGIONS OF DAMAGE CREATED BY COLLISION CASCADES IN α-IRON. Platonov, P. A.; Krasnoshtanov, V. F.; Kevorkyan, Yu. R. At. Energ. (USSR); 39: No. 4, 260-264(Oct 1975). (In Russian).

The formation and annealing of defects in regions of damage created by cascades of atomic collisions in α-iron have been investigated by means of computer simulation. As a function of energy of primary knocked-out atom, the following characteristics of damage regions at 0°K were obtained: volume of region, number of defects, their spatial distribution, and distribution of clusters of defects according to size. For the 5-keV region, results of isothermal annealing at 300 and 800°K are presented.

30278 CASCADE DAMAGE EFFECTS ON THE SWELLING OF IRRADIATED MATERIALS. Bullough, R.; Eyre, B. L.; Krishan, K. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. R. Soc. (London), Ser. A; 346: No. 1644, 81-102(14 Oct 1975).

The homogeneous rate theory of void growth is extended to include the possibility of forming vacancy loops when the irradiation produces cascade damage. The analysis provides a basis for understanding and correlating the relative swelling generated during electron, heavy ion, and fast neutron irradiation. In order to illustrate the physical features of the model it is applied in some detail to calculating the volume swelling in solution treated M316 stainless steel for which there is a considerable amount of experimental data. The results from these calculations serve to expose the sensitivity of void swelling to the scale on which interstitial loops are nucleated. They also highlight the particular difficulty arising from the continuous generation of transmutation gas in predicting swelling under neutron irradiation at elevated temperatures. (auth)

30279 FORMATION OF VACANCY CLUSTERS IN COPPER IRRADIATED WITH 5 keV ARGON IONS. Hertel, B.; Diehl, J. (Max-Planck Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi (a); 33: No. 2, K73-K75(16 Feb 1976).

Bombardment of Cu with 5-keV Ar ions was extended to lower doses (5×10^{11} to 5×10^{14} Ar$^+$/cm^2) and high-resolution TEM used to observe the resulting defects. No defects were seen under bright-field conditions except at the highest dose, but defects could be observed at all doses under weak-beam conditions. Defect size is estimated to be 1 to 2 nm. Number density increases linearly with dose up to 10^{13} Ar$^+$/cm^2, with saturation at higher doses. The defects are produced in a narrow layer close to the surface and are of vacancy type. (DLC)

30280 NEUTRON-EXCITED ELASTIC WAVES IN FISSIONABLE MATERIALS. Volovik, V. D. (Kharkov State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 145-147(1975). (In Russian).

A method is developed for the calculation of the thermoacoustical effect excited by neutrons in fissionable material. It can be used for evaluation of the acoustical effects from gamma beams and high-energy charged particle beams in targets of fissionable material. The distribution of the energy release of the γ quanta in the depths of the target and the distribution of the density of fissioning particles in the target can also be solved with the method developed. (JSR)

30281 VARIOUS ASPECTS OF IONIC MACHINING APPLIED TO METALLIC SYSTEMS IN MICROWAVE DIPOLAR TRANSISTORS. Pestie, J. P.; Dumontet, H.; Andrieu, J. P. (Compagnie Generale d'Electricite (CGE), 91–Marcoussis (France)). pp 161-170 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French).

From fourth international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces no. 171.

The positive benefit of ion bombardment machining in fabricating bipolar microwave transistors is shown. Ion cleaning, especially for P type silicon with high boron concentration, allows reproducible surface resistivities to be reached 10^{-6} ahms/cm^2 and the spurious resistance of the base to be minimized. Ionic etching of metallic layers allowed 1 μm stepped geometric structures to be realized. The multilayer Ti–Pt–Au system was associated to the finest geometries through a finite number of operations.

30282 FABRICATION, DUPLICATION, AND EXAMINATION OF PASSIVE INTEGRATED OPTICAL COMPONENTS. Ostrowsky, D. B.; Roy, A. M. (Thomson-CSF, Domaine de Corbeville, 91–Orsay (France)). pp 199-208 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974).

From fourth international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces No. 171.

Using a computer-controlled electron microscope for delineating the complex structures of optical waveguides and an electron beam method for the fast duplication of these structures is discussed. Circuits obtained are presented and means for their characterization are discussed.

30283 ELECTRICAL RESISTIVITY OF FAST NEUTRON IRRADIATED BISMUTH. Quelard, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section d'Etude des Solides Irradies). J. Phys. (Paris), Lett.; 36: No. 10, L.247-L.248(Oct 1975). (In French).

The production and recovery of fast neutron radiation damage in bismuth at 20°K has been studied by means of electrical resistivity. Results are independent of crystallographic orientation and indicate a creation of carriers during irradiation.

30284 RESISTANCE OF ORGANIC AND INORGANIC MATERIALS TO HIGH-ENERGY RADIATION. van de Voorde, M.; Lambert, K. P.; Schoenbacher, H. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 505-514 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

Requirements for a large variety of radiation resistant materials are made for the existing CERN high-energy installations, the 28-GeV Proton Synchrotron and the Intersecting Storage Rings, as well as for the Super Proton Synchrotron at present under construction which will accelerate protons up to 400 GeV/c. Organic and inorganic materials used for magnets and cable insulations, for vacuum seals, supports, optical devices, etc., have been subjected to radiation damage tests. In order to make predictions and recommendations on the lifetime of such materials in a nuclear radiation field, accelerated tests have been carried out in various sources under combined environmental conditions mainly in nuclear reactors. The conclusive results of these tests are given and the validity of such simulating tests is discussed, based on the experience gained around the CERN accelerators now in operation for more than ten years. (FR)

30285 RADIATION EFFECTS ON SECOND SURFACE MIRRORS. Fogdall, L. B.; Cannaday, S. S. (Boeing Co., Seattle, Wash. (USA)). pp 549-560 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

Second surface mirrors used for spacecraft temperature control have recently been evaluated in various space radiation environments simulated in the laboratory. The spectral reflectance and solar absorptance properties of these fused silica/silver mirrors were investigated extensively in a number of tests. Radiation exposures included several combinations of protons between 3 keV and 80 keV energy, electrons between 20 keV and 230 keV energy, and ultraviolet radiation between one and 16 suns in intensity and up to 20,000 equivalent sun hours. Particle fluences ranged from 10^{14} to more than 10^{16} per square centimeter. Important new and confirmatory information has been learned about (1) the radiation resistance of fused silica; (2) the significance of bonding agents (adhesives) in introducing degradation, self-contamination, and cross-contamination; and (3) the necessity for test chamber cleanliness. Several tests showed that RTV silicone adhesive will outgas from hot mirrors and creep from underneath cold mirrors onto adjacent reflective surfaces, contaminating them. Repolymerization of the silicone also occurs under the influence of incident radiation, altering the thermophysical properties of test samples in ways that may or may not represent an adequate simulation of space condition. Quantitative values and qualitative effects are included in the paper. It has been concluded that fused silica itself is quite stable during exposure to various combinations of natural space radiation, but that use of organic materials on a spacecraft in the vicinity of fused silica mirrors may significantly compromise their stability and performance. (FR)

30286 HALL-EFFECT MEASUREMENTS IN Cd-IMPLANTED GaAs. Shin, B.K. (Systems Research Laboratories, Incorporated, 2800 Indian Ripple Road, Dayton, Ohio 45440); Look, D.C.; Park, Y.S.; Ehret, J.E. J. Appl. Phys. 47: No. 4, 1574-1579 (Apr 1976).

Cadmium ions were implanted in GaAs crystals at 135 keV to doses ranging from 10^{12} to 10^{16} ion/cm^2 at room temperature. Sheet-resistivity and Hall-effect measurements were carried out as a function of temperature, 4.2–300°K, after annealings at 700, 800, or 900°C in an Ar ambient. The sample surfaces were protected with pyrolytically deposited Si_3N_4. Significant *p*-type conduction was observed when samples with doses $\gtrsim 10^{13}$ cm^{-2} were annealed at $\gtrsim 700$°C. For doses below 10^{14} cm^{-2} nearly complete electrical activity was attained after an 800-900°C anneal. The Cd profiles were determined by differential Hall-effect measurements in conjunction with the acid-etch layer-removal technique. Above about 800°C diffusion becomes important and significantly flattens the implantation profile. (auth)

30287 UEBER DIE BILDUNG UND DAS AUFBRECHEN VON GASBLASEN IN NIOB BEI BESCHUSS MIT 0.5 BIS 9 keV HELIUM IONEN. (Formation and the Breaking up of Gas Bubbles in Niobium at a Bombardment With Helium Ions With Energies in the Range From 0.5 to 9 keV). Roth, J. Munich; Technische Universitat (1974). 50p.

A method for the determination of the in-depth distribution of lattice defects in single crystals is briefly described. The method is based on Rutherford backscattering of energetic light ions. A computational model regarding the relation between back-scatter intensity and lattice-defect concentration is used for the study of radiation damage in niobium single crystals exposed to helium-ion bombardment, taking into account a temperature range from 150 to 1300 K. The large penetration ranges of the ions observed under random bombardment conditions could be verified in computer simulations. Form and size of the formed bubbles were studied with the aid of a scanning electron microscope.

Other Materials

Refer also to abstracts 28311, 28528, 28825, 28868, 29437, 29958, 29962, 30027, 30156, 30170, 30171, 30256, 30284, and 31970.

30288 (AD/A-008781) STRENGTH CHARACTERISTICS OF BORON ALUMINUM COMPOSITE SUBJECTED TO COMBINED STRESSES. Final Report, 1 Jan 1973-30 Jun 1974. Thomas, R. L. (Washington Univ., St. Louis, Mo. (USA). Materials Research Lab.). Oct 1974. Contract F33615-73-C-5026. 103p. NTIS $5.25.

Quasi-static combined stress experiments were performed on 50 vol percent unidirectional Al/B Composites. The Failure Tensor Polynomial Criterion correlated the experimentally determined failure surface within empirical accuracy. This program has also shown that the compressive axial strength is significantly greater than the tensile axial strength. Combined axial and shear stress fatigue testing has been demonstrated and the results suggest that Al/B composites have good resistance to combined axial-shear fatigue. Preliminary exploration indicates that the stress path may have a significant influence on strength. Additional work in this area is desirable. (GRA)

30289 (CEA-CONF-3154) NEUTRON IRRADIATION BEHAVIOR OF DIFFERENT CLASSES OF CARBONS. Rappeneau, J.; Micaud, G.; Marchand, A.; Pacault, A.; Amiell, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Dept. de Technologie). 1975. 31p. (In French). INIS.

From 12th biennial conference on carbon; Pittsburgh, USA (28 Jul 1975).

The electronic properties of various carbons have been studied as a function of irradiation (neutron) dose and annealing. A general interpretation in terms of positive holes (in the valence band) and localized or delocalized paramagnetic centers created by the displacement of carbon atoms due to neutron irradiation is given. Different classes of carbons may be defined and an equivalent dose is used to characterize each carbon in its class. The irradiation and annealing behavior of graphites and pyrocarbons may also be visualized through their paths in a Hall effect–magnetic susceptibility two-dimensional space.

30290 (CONF-750249) PROCEEDINGS OF THE NATIONAL SYMPOSIUM ON THERMOLUMINESCENCE AND ITS APPLICATIONS, KALPAKKAM, MADRAS, INDIA, FEBRUARY 12-15, 1975. (Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.). 1975. 710p. Bhabha Atomic Research Centre, Bombay.

Papers were presented on basic mechanisms of thermoluminescence, and on applications in radiation dosimetry, archaeology, and geology. Separate abstracts were included for 53 of the papers. (SFL)

For abstracts of individual papers see: 29291–29313, 29492, 29667, 30002, 30003, and 30313–30338.

30291 (CRN-CNPA-75-16) ^{121}Sb MOESSBAUER SPECTROSCOPY IN ALKALI ANTIMONY (V) HEXAFLUORIDES. Devort, J. P.; Friedt, J. M. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Centre de Recherches Nucleaires). 1975. 8p. INIS.

The dependence of the isomer shift of ^{121}Sb on the alkali cation in the $MSbF_6$ (M = Li, Na, K, Rb, Cs and NH_4) series is investigated and discussed in terms of a varying electron transfer from the cation of the SbF_6-molecular ion. (FR)

30292 DEFORMATION PROPERTIES OF IRRADIATED POLYETHYLENE WITH HIGH DENSITY. Demirev, A.; Kostov, G.; Panajotova, B.; Bakalova, Z. Neft Khim.; 11: No. 1973, 469-476(1974). (In Bulgarian)

Gamma radiation effects on the deformation properties of Bulgarian polyethylene Bulen A-15 with molecular weight 113000 (flow index 1,72 g/10 min) were investigated. The dependence of the relative elongation on radiation dose, temperature, and tension was studied. The experiments have been carried out at 30, 45, 60°C and initial tensions of 30, 45, 60, 80, and 100 kg/cm^2, at 300 to 350 hours. The deformation changes are measured with a cathetometer with accuracy of 0.01 mm. The relative elongation at rupture decreases from 340 to 90% at correspondent increase of the fluidity, boundary and tensile strength. The content of the gel fraction increases from 0% for unirradiated polyethylene to 57.7% for polyethylene with 50 mrad radiation dose absorbed. The exponential function $E = At^{\alpha}$ is proposed for description of deformation of the radiation modified polyethylene, where the constants A and α depend on the radiation dose and are determined by data processing. Mean square error calculated by computer is about 3%. The results obtained give possibility to predict the behavior of the polymer at long static load. (INIS)

30293 METHOD OF PRODUCTION OF WOOD-PLASTICS PRODUCTS. Bell, B. V. (to Atlantic Richfield Co., New York (USA)). German(FRG) Patent 1953236/C/. 12 Jun 1975. 20p. (In German).

Wood-plastic composite products are impregnated whereby a lacquer formation and a surface depletion are avoided to a great extent. The impregnation is done with a monomer compound such as vinyl monomers or polymethyl acrylate, polyacrylate, ethyl acrylate with vinylidene chloride, acryl nitrile and styrene, which are suitable for polymerization. Gamma radiation from a Co-60 or cesium-137 source of 1-2 megarad is used for this. Furthermore, a fire-resistive medium, e.g., an organo-phosphorous polymer, in the concentration region of 8-12% and an oil-soluble dye of, e.g., 1% beta naphthol to reduce the lacquer formation is added to the monomer. Furthermore, an inhibitor such as butylate

hydroxide toluene of 35 ppM and an activator such as carbon tetrachloride may be added. Suitable impregnation mediums for red oak strips consist of 89% methyl methacrylate, 10% organo phosphorous polymer and 1% beta naphthol. (DE)

30294 EFFECT OF GAMMA IRRADIATION ON VARIOUS POLYMERIC MATERIALS. Postrigan, M. V.; Nikitina, L. A.; Raikhlin, L. B.; Krivonosov, A. I. Med. Tekh.; No. 4, 7-9(1974). (In Russian).

The effect of γ radiation on six plastic materials used in the manufacture of single-use medical supplies was reported. The plastics studied were a high and low density polyethylene, a polymethylmethacrylate, a plasticized resin, polystyrene, and a polystyrene copolymer with methylmethacrylate and butyl latex. The tabulated results show changes in all the polymers studied. However the changes were not such as to preclude their use and therefore their radiosterilization is recommended. (JSR)

30295 PHOTO-STIMULATED DESORPTION FROM CdS SURFACE. Lazneva, E. F.; Bykova, T. T. Vestn. Leningr. Univ., Fiz., Khim.; No. 3, 53-55(Aug 1975). (In Russian)

Photodesorption of O_2 and $C_6H_4O_2$ from a CdS surface was investigated simultaneously. The amount of desorbed species was measured as a function of the light pulse intensity and so lux-current dependences for both absorbents were obtained. The results indicate the similarity of behavior of acceptor absorbents on the CdS surface. (auth)

30296 SUBTHRESHOLD RADIATION EFFECTS IN SEMICONDUCTORS. Vavilov, V. S.; Kiv, A. E.; Niyazova, O. R. (Lebedev Inst. of Physics, Moscow). Phys. Status Solidi (a); 32: No. 1, 11-33(16 Nov 1975).

Aspects of radioinduced point defect generation in crystals are analyzed and reviewed. Information is included on elastic displacement of atoms from lattice sites in semiconductors, subthreshold radiation effects in semiconductors, and microscopic mechanisms of subthreshold defect generation in semiconductors. (JRD)

30297 F-CENTERS IN CALCIUMCHLORAPATITE DOPED WITH NaCl. Knottnerus, D. I. M.; den Hartog, H. W.; Lanjouw, A. (Univ. of Groningen, Netherlands). Phys. Status Solidi (a); 32: No. 1, 287-295(16 Nov 1975).

EPR and optical absorption experiments at 300°K on x-irradiated synthetic calcium-chlorapatite single crystals doped with NaCl are presented. Two different EPR signals due to electron-excess centers have been observed. The signals are assigned to two types of F-like color centers, for which models are given. (auth)

30298 Λ-TYPE DOUBLING IN SiH MOLECULE. Wilson, I. D. L.; Richards, W. G. (Oxford Univ.). Nature (London); 258: No. 5531, 133-134(13 Nov 1975).

It is stated that there has recently been much interest in the possibility of determining the radio-frequency spectra of interstellar molecules. SiH is of interest as a probable interstellar species. In this case the only available prediction for the radio-astronomical frequency band can be made by extrapolating Λ-doubling from high rotational levels populated, in laboratory experiments, to low rotational levels. Calculations are more difficult for SiH than for the similar CH species, since less is known about the perturbing excited states, and complications are introduced by the presence of a second row atom. Nevertheless predictions can be made if certain approximations are introduced. Theoretical predictions are here compared with experimental extrapolations, and the agreement is found to be sufficiently close to provide encouragement for a search for the molecule in interstellar space to be made, using available receivers. (UK)

30299 CRYSTALLIZATION AND POLYMORPHISM OF RARE EARTH OXYMOLYBDATES WITH THE COMPOSITION Ln_2MoO_6. Klevtsov, P. V.; Kharchenko, L. Yu.; Klevtsova, R. F. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Sov. Phys.–Crystallogr. (Engl. Transl.); 20: No. 3, 349-353(1975).

Translated from Kristallografiya; 20: No. 3, 571-578(1975).

The oxymolybdates Ln_2MoO_6, where Ln is any rare earth element (except Ce), were synthesized by crystallization from solution in a melt of alkali-metal chlorides. It was found that they can crystallize in three structural modifications: a low-temperature monoclinic form isostructural with the oxytungstate Nd_2WO_6 (a whole series of compounds); a modification with an unknown fluorite-like structure; and a high-temperature tetragonal form, isostructural with La_2MoO_6 (the last two modifications were obtained for Ln = La, Pr, and Nd). The crystal structure of α-Sm_2MoO_6 was determined. Results indicated that the $\alpha \rightleftharpoons \beta \rightleftharpoons \gamma$ transformations which were accompanied by the redistribution of the cations in the structure while still retaining their relative positions, occurred very slowly.

30300 NEGATIVE-PULSE THERMAL-DIFFUSIVITY MEASUREMENTS OF ATJ-S GRAPHITE TO 3500°K. Lincoln, R. C.; Heckman, R. C. (Sandia Labs., Albuquerque, NM). High Temp.–High Pressures; 7: No. 1, 71-77(1975).

The thermal diffusivities of ATJ-S graphite, both parallel and perpendicular to the pressing direction, between 2000 and 3500°K are reported. The results for both directions show a smooth decrease with increasing temperature. A sharp decrease in diffusivity at the highest temperatures, as suggested by some earlier measurements on graphites, is not observed. The measurements were made by the negative pulse technique. Since the method is new, experimental details are discussed and some results of measurements on AXM-5Q graphite are given for comparison with published values. (auth)

30301 THERMODYNAMICS OF THE ACTINOID ELEMENTS. V. Enthalpies and Gibbs Energies of Formation of Some Protactinium (IV) and (V) Halides. Fuger, J. (Univ., Leige); Brown, D. J. Chem. Soc. (London), Dalton Trans.; No. 21, 2256-2263 (1975).

The following enthalpies of solution (kJ mol^{-1}) have been measured: protactinium metal in oxygen-free 12M-HCl–0.05M-HF to yield Pa^{IV}, -666 ± 13, and in 12M-HCl–0.05M-HF containing oxygen to yield Pa^{V}, -817 ± 15; $PaCl_4$(s) in oxygen-free 12M-HCl–0.05M-HF and 12.05M-HCl, -160.9 ± 2.6 and -105.9 ± 2.5, respectively; and $PaCl_5$(s) and $PaBr_5$(s) in 12M-HCl–0.05M-HF, -203.2 ± 3.0, and -242.0 ± 5.0, respectively. Combination of these values with previously reported enthalpies of solution for other thermodynamic data yields the following enthalpies of formation (in kJ mol^{-1}) at 298 K: Pa^{IV} in 1 and 6M-HCl, -620 ± 13 and -608 ± 13, respectively; Pa^{V} in 12M-HCl–0.05M-HF, -672 ± 15; PaF_4(s), -1.918 ± 30; $PaCl_4$(s), -1.045 ± 13; $PaBr_4$(s), -827 ± 13; $PaCl_5$(s), -1.143 ± 15; $PaBr_5$(s), -865 ± 16; and $Cs_2[PaCl_6]$, -2.011 ± 13. By use of suitably interpolated entropy and heat-capacity data, thermodynamic functions associated with formation of the halides have been calculated as a function of temperature. (auth)

30302 DOPING CENTERS IN PARTIALLY ANNEALED CARBON IMPLANTED SILICON. Smith, B. J.; Stephan, J.; Hammersley, P. J. (United Kingdom Atomic Energy Authority Research Group, Harwell, Eng.). Radiat. Eff.; 26: No. 1-2, 17-21 (Sep 1975).

Carbon ions have been implanted into p-type silicon at energies in the range 1.5 to 4.3 MeV in order to examine the doping effects of the damage. Carbon was chosen since it does not produce impurity doping and hence damage effects alone could be observed. Capacitance-voltage doping profiles showed that initially two p-type doping peaks were produced. On annealing to 400°C the p-type activity increased, then disappeared completely after a 700°C anneal. The deeper peak disappeared at a lower annealing temperature. These observations have been used to interpret anomalous results that have been observed in incompletely annealed ion implanted MOST's, where it had been suspected that the overall doping effect was produced by a combination of impurity and damage doping centers. (auth)

30303 NEW RESULTS IN THE CHARACTERIZATION OF DEFECTS IN PHOSPHOROUS ION-IMPLANTED SILICON. Seshan, K.; Washburn, J. (Univ. of California, Berkeley). Radiat. Eff.; 26: No. 1-2, 31-37(Sep 1975).

Defects in annealed P^+ ion-implanted silicon (p type), implanted to below the critical dose to form a continuous amorphous layer, were found to be faulted hexagonal Frank loops ($\sim 10^{16}$/cm^3, 200 Å in diameter) on the four {111} planes. A few unfaulted loops and linear defects ($\sim 10^{13}$/cm^3, ~800 Å in length) along the ⟨110⟩ directions were also present. The loops showed contrast effects indicative of solute segregation within the loop. The displacement vectors are then of the type a/x [111] with x slightly greater than three. The loops were all interstitial suggesting that they form from the conversion and growth of small interstitial clusters formed during implantation. Segregation of dopants to these interstitial clusters could account for the poor electrical activity of phosphorus in foils implanted to below the critical dose and annealed in the 500 to 700°C range. Studies of n-type (P and Sb doped) foils show that defect morphology varies with foil type (n- or p-) and dopant species present prior to implantation. Evidence that the linear defects are interstitial type, that they anneal from the end near the free surface and that boron is necessary for their formation is also presented. (auth)

30304 LYOLUMINESCENCE OF IRRADIATED ALKALI HALIDES. Atari, N. A.; Ettinger, K. V. (Aberdeen Univ., Eng.). Radiat. Eff.; 26: No. 1-2, 39-41(Sep 1975).

The lyoluminescence response of sodium chloride to radiations of different nature and energy is discussed. Irradiation with ^{60}Co or ^{137}Cs γ-rays and ^{90}Sr/^{90}Y β-particles gave results suggesting equal sensitivity to these radiations, whilst the response to α particles from ^{241}Am was only 20% of that for β-rays. The pre-

irradiation thermal and mechanical treatment of the pulverized salt had a significant effect on its lyoluminescence yield and also on the stability of stored energy imparted by radiation. The higher the dose given to the sample, the more stable became the color centers responsible for the lyoluminescence. (auth)

30305 ENERGY LOSS OF LOW ENERGY PROTONS CHANNELING IN SILICON CRYSTALS. Melvin, J. D.; Tombrello, T. A. (California Inst. of Tech., Pasadena). Radiat. Eff.; 26: No. 1-2, 113-126(Sep 1975).

Experimental energy loss measurements were made for protons of energy 0.5 to 1.6 MeV channeling through 1 μm thick silicon targets along the ⟨110⟩, ⟨111⟩, and ⟨211⟩ axial directions and the {100}, {110}, {111}, and {211} planar directions. These data have a precision of ±5% and are presented graphically along with an extensive summary of other data in the literature. The new data cover a wider range of channels than has previously been examined with protons and are in agreement with the helium data of Eisen et al (Rad. Effects; 13:93(1972)). A standard theory of energy loss is summarized and amplified, and straggling is calculated theoretically. Local electron densities for various channels in silicon are extracted from plane and row averaged Thomas-Fermi potentials via $\nabla^2 V = 4\pi\rho$, and are used in the theoretical energy loss and straggling equations. The results agree with the experimental data to within 5%. The need for more precise measurements in order to make a decisive test of the theory is discussed. (auth)

30306 DEFECTS IN ELECTRON-IRRADIATED LiF SINGLE CRYSTALS AT VARIOUS STAGES OF IRRADIATION AND ANNEALING. Zefirova, V. L.; Kolontsova, E. V.; Telegina, I. V. (Moscow State Univ.). Sov. Phys.–Crystallogr. (Engl. Transl.); 20: No. 3, 359-361(1975).

Translated from Kristallografiya; 20: No. 3, 588-591(1975).

The effect of electron irradiation over the dose range 10^{16} to $2.2 \cdot 10^{18}$ cm^{-2} on single crystals of LiF was studied by diffuse and small-angle x-ray scattering, by the Laue method, and by the precision determination of the unit-cell parameter, using the Bond method. On the basis of the data obtained and the behavior of crystals annealed after irradiation, the nature of the defects at various stages of irradiation and annealing was analyzed. (auth)

30307 γ-RADIATION DAMAGE EFFECTS ON PLASTIC SCINTILLATORS. Oldham, G.; Ware, A. R. (Loughborough Univ. of Tech., Eng.). Radiat. Eff.; 26: No. 1-2, 95-97(Sep 1975).

The effect of radiation damage on a number of different scintillating materials has been investigated by measuring the apparent maximum energy change represented by the shift in the β-spectrum end-point obtained from ^{204}Tl. The damage curves have been shown to be represented by the equation $y = A(1 - e^{-Bx})$ where y is the percentage apparent energy change, x is the radiation dose in Mrad, and A and B are constants. The form of the equation remains the same for varying dose rates and materials although the values of A and B alter. It would appear that, for the samples examined, over 60% of the measured damage is due to the production of color in the plastic, the remainder of the damage being produced in the actual scintillating chemicals themselves. (auth)

30308 SUPERCONDUCTIVITY OF SOME NaCl STRUCTURE SULFIDES, SELENIDES, AND PHOSPHIDES. Moodenbaugh, A. R. San Diego, CA; Univ. of California (1975). 169p. University Microfilms Order No. 76-2309.

Thesis (Ph. D.).

The superconducting behavior of some NaCl defect structure sulfides, selenides, and phosphides was investigated. Binary compounds discovered to be superconducting along with the maximum observed midpoints of transition temperatures (T/sub c/'s) are: ScS, T/sub c/ equals 4.5 K; ThS, T/sub c/ equals 0.49 K; ScSe, T/sub c/ equals 3.7 K; ThSe, T/sub c/ equals 1.72 K; $ZrP_{0.95}$, T/sub c/ equals 4.8 K; HfP, T/sub c/ approximately 4 K; and ThP, T/sub c/ approximately 0.2 K. The maximum observed T/sub c/'s in the following systems are: Zr/sub 1-x/S, T/sub c/ approximately 4 K; LuS, T/sub c/ equals 1.6 K; and YS, T/sub c/ equals 2.88 K. T/sub c/ as a function of composition was determined in the NaCl defect structure compounds Zr/sub 1-x/S (0.09 less than or equal to x less than or equal to 0.22), YS/sub x/ (0.93 less than or equal to x less than or equal to 1.05), and Sc/sub 1-x/S (0.00 less than or equal to x less than or equal to 0.07). In the last two systems T/sub c/ was found to have a maximum at the 1:1 composition. In the Zr/sub 1-x/S system the maximum T/sub c/ was observed near the composition $Zr_{0.83}S$. T/sub c/ as a function of pressure was established in the NaCl defect structure compounds Zr/sub 1-x/S, YS, LuS, ThSe, $ZrP_{0.95}$. T/sub c/ was found to fall as pressure was increased except in the case of Zr/sub 1-x/S. Room temperature magnetic susceptibility measurements and low temperature heat capacity measurements were performed on Zr/sub 1-x/S, $Sc_{0.99}S$, and $ZrP_{0.95}$ NaCl defect structure samples. Magnetic susceptibilities are 19.2×10^{-6} cm^3/(mole $Zr_{0.83}S$), 37.7×10^{-6} cm^3/(mole $Sc_{0.99}S$), and $30.3 \times 10^{-6} cm^3$/(mole $ZrP_{0.95}$). Electronic specific heat capacity coefficients (gamma's) in mj/(mole K^2) are 3.1 for $Zr_{0.83}S$, 3.4 for $Sc_{0.99}S$, and 3.8 for $ZrP_{0.95}$. (Diss. Abstr. Int., B)

30309 STRUCTURAL AND MAGNETIC PHASE TRANSITIONS IN THE COOPERATIVE JAHN–TELLER SYSTEMS: $TbVO_4$ AND $TbAsO_4$. McPherson, J. W. Tallahassee; Florida State Univ. (1975). 170p. University Microfilms Order No. 76-2669.

Thesis (Ph. D.).

Effects of a magnetic field on the behaviors of $TbVO_4$ and $TbAsO_4$ which show cooperative Jahn–Teller phase transitions were investigated. The possibility that the systems will return to the undistorted phases at low temperatures in a magnetic field is considered. It is shown that because of the weak coupling of the systems to a magnetic field along the c-axis, the magnetic field required to see the transition of the crystals back to the undistorted phase is impractically high. Diluting the crystals with nonmagnetic ions is then proposed as a plausible approach in the study of this novel behavior of the systems. Effects of a magnetic field applied in the basal plane were calculated and it is shown that the crystals would remain distorted for all temperatures except the cases when the field is applied along the crystallographic axes. $TbAsO_4$ and $TbVO_4$ order magnetically at low temperatures. It is suggested that the induced-moment magnetism of these two cooperative Jahn–Teller systems can be studied experimentally by applying an appropriate stress to the crystal. The constant-coupling approximation is then applied to the transverse Ising model, which is used to describe the induced-moment magnetism that occurs in these singlet-singlet systems. By selecting the effective nearest-neighbor exchange interaction parameter from the T equals 0 energy level splitting of $TbAsO_4$, one obtained a T/sub N/ within 7 percent of the observed value, a very rapid rise in the energy level splitting near T/sub N/ in agreement with the experiment, and a much better fit to the specific heat than that predicted by the molecular field approximation. The much better quantitative results obtained from the constant-coupling approximation over the molecular field approximation indicates that short range interactions play an important role in the magnetic ordering of $TbAsO_4$. (Diss. Abstr. Int., B)

30310 RESIDUAL LATTICE DAMAGE IN As-IMPLANTED AND ANNEALED Si. Mader, S.; Michel, A.E. (IBM System Products Division, East Fishkill, Hopewell Junction, New York 12533). J. Vac. Sci. Technol. 13: No. 1, 391-395 (Jan 1976).

Residual damage in Si was examined by TEM after shallow As^+ implantations (40–150 keV) and annealing in the temperature range of 800°–1000 °C. After annealing at 800 °C the damage consists of many small interstitial-type prismatic dislocation loops. The structures obtained after annealing at higher temperatures are different for implantations into Si covered with a thin (100–200 A) layer of SiO_2 and for implantations of large prismatic dislocation loops and half-loops intercepted by the Si surface, whereas implantation through oxide results in a layer of irregularly shaped dislocation loops which is not connected to the surface. The development of these structures is discussed as arising from the healing of ion-bombardment damage and the diffusion of As into deeper regions of Si and from an influence of recoiled O atoms for implantations through SiO_2 layers. (auth)

30311 PHOTO-EMISSION STUDY OF BETA RHOMBOHEDRAL BORON. Arsen'eva-Geil, A. N.; Berezin, A. A.; Mel'nikova, E. V. Fiz. Tverd. Tela; 17: No. 8, 2448-2449(Aug 1975). (In Russian).

The photo-emission characteristics of β-rhombohedral B single crystals were studied; the spectral dependence of the quantum yield and the energy distribution of the photo-electrons were established by the retarding-field method in a spherical capacitor. The photoelectron work function so determined was 4.3 ± 0.1 eV. The thermionic work function was 3.8 ± 0.1 eV. On analyzing these and other data the scheme of energy levels proposed by Kuber et al. (Phys. Status Solidi (b), 1973, 60, 117; Met A., 7404-33 0802) was refined; the Fermi level of β-D apparently lay 0.4 to 0.5 eV above the top of the valence band.

30312 THERMODYNAMIC STUDIES OF CONDENSED PHASES BY HIGH TEMPERATURE MASS SPECTROMETRY. Analysis of the Method and Results. Chatillon, C. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France); Pattoret, A.; Drowart, J. High Temp.–High Pressures; 7: No. 2, 119-148(1975). (In French).

Methods used in high-temperature mass-spectrometric studies for the determination of the thermodynamic properties of condensed phases are reviewed. The principal experimental difficulties and sources of error are analyzed. Comprehensive bibliography covers literature up to 1974. (auth)

30313 UNDERSTANDING OF THERMOLUMINESCENCE. Ganguly, A. K. (Bhabha Atomic Research Centre, Trombay, India). pp 1-26 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

A review of observations on thermoluminescence (TL) is presented. Information is included on TL glow peaks, charge transfer between traps, sensitization of phosphors, and energy balance and TL. (JRD)

30314 THERMOLUMINESCENCE STUDIES OF CaS:Tb^{+3} PHOSPHORS. Awate, A. V. (Shivaji Univ., Kolhapur, India); Jambagi, N. M.; Narlikar, A. V. pp 27-33 of Proceedings of the National Symposium on Thermoluminescence and Its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Thermoluminescence properties of calcium sulfide phosphors doped with varying concentrations of Tb^{+3} were systematically studied. Activation energies were calculated using the shape of the glow curves and found to be in mutual agreement. The kinetics of the processes was found to be bi-molecular. Conclusions are drawn regarding the possible role of activator in thermoluminescence behavior.

30315 THERMOLUMINESCENCE OF CaS:Dy PHOSPHORS. Shalgaonkar, C. S. (Shivaji Univ., Kolhapur, India); Narlikar, A. V. pp 34-39 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

CaS phosphors activated with Dy^{+3} impurities in varying concentrations have been prepared. Their thermoluminescence behavior has been studied in the temperature range of 300 to 500°K. The general features of the glow curve have been discussed. The values of activation energies have been estimated by the initial rise method, Lushchik's method, Grossweine's method, and Halperin-Braner's method and compared. Also attempts are made to determine the type of kinetics involved in thermoluminescence process. This has been compared with results of phosphorescence decay studies.

30316 THERMALLY STIMULATED LUMINESCENCE OF CaS:Tm PHOSPHORS. Pawar, S. H. (Shivaji Univ., Kolhapur, India); Narlikar, A. V. pp 40-45 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Calcium sulfide phosphors embedded with various concentrations of thulium have been prepared by thermal reduction of gypsum. Defect levels were observed in CaS lattice by employing the glow technique. The glow curves are recorded in the temperature range of 96 to 400°K at five different heating rates in the range of 0.2°K/s to 1.2°K/s. The recorded glow curves reveal three glow peaks below room temperature. The peaks are isolated by the method of thermal cleaning. They are analyzed by the methods of Halperin and Branner, and Chen. The estimated values of defect levels corresponding to three glow peaks lie at about 0.23 ± .01, 0.39 ± .01, and 0.53 ± .01 eV. The method of Hoogenstraaten has been modified to analyze the glow curves. The plots of log (ST_g/β) versus $1/T_g$ are found to be straight lines, the slopes of which are the values of defect levels. These values are in good agreement with those of the other methods. The effect of heating rates on glow peak temperatures is also discussed. (auth)

30317 MECHANISM OF THERMOLUMINESCENCE EMISSION DUE TO LEAD AND NICKEL CENTERS IN ALKALI HALIDES. Sastry, S.B.S. (Indian Inst. of Tech., Madras); Viswanathan, V. pp 46-51 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

In the thermoluminescence studies on x-irradiated lead doped and nickel doped alkali halides some new glow peaks are observed though the TL output has been considerably reduced as compared with undoped crystals. In NaCl : Ni crystals two new glow peaks are observed at 110 and 142°C. It is found that the spectral emission region for the TL output due to F-centers shift to longer wavelengths as compared with undoped crystals: for example in NaCl : Pb the spectral emission is in 510 to 540 nm region as compared with that of undoped crystals which emit in 480 to 510 nm region. An interesting difference between lead doped and nickel doped crystals is that the emission region of the new glow peaks in the former is different from that due to F-glow and in the latter the emission is in the same region as that due to F glow. In the light of this and other experimental evidence, the mechanism of emission of the new glow peaks in these crystals is discussed. (auth)

30318 THERMOLUMINESCENCE STUDIES IN LEAD DOPED KCl AND KBr CRYSTALS. Sastry, S.B.S. (Indian Inst. of Tech., Madras); Viswanathan, V. pp 52-61 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Lead is known to enter substitutionally in divalent state when doped in alkali halides. When irradiated at room temperature these lead centers (Pb^{++}) act as traps for electrons knocked off from the halogen ions and become Pb^{+} and Pb^{0} (for large doses of irradiation). These changes could be followed in the optical absorption studies. These lead doped crystals after x-ray irradiation yield a thermoluminescence output smaller than that observed in undoped crystals. However, two new glow peaks are observed in addition to those due to F-centers. In NaCl : Pb crystals these new peaks are observed at lower temperatures than those due to F-centers. In KCl : Pb and KBr : Pb crystals part of the F-center glow precedes the new glow peaks. These new peaks are attributed to the Pb^{+} and Pb^{0} centers. The glow peak temperatures and trap depths for these peaks as obtained by Total Curve Fitting method are reported.

30319 THERMOLUMINESCENCE STUDIES IN CERTAIN DOPED NaCl CRYSTALS. Sastry, S.B.S.; Subbanna, C. N. (Indian Inst. of Tech., Madras). pp 62-67 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Cerium is known to enter substitutionally in trivalent state when doped in alkali halides. Cerium doped NaCl crystals exhibit greatly enhanced thermoluminescence output upon x-irradiation at 23°C, the intensity of emission being more than that in undoped crystals for similar dosage of irradiation. The cerium doped crystals give, upon x-irradiation, a very intense glow peak at 145°C with shoulders at 120 and 210°C. Upon partially bleaching the crystal with F-light, the peak at 120°C becomes prominent, probably due to faster bleaching of the glow at 145°C. It is concluded that the glow peak at around 120°C is due to cerium centers in the irradiated crystal and the 145°C peak due to F centers. The F center emission occurs at lower temperature, compared with that in the undoped crystals where it occurs at around 180°C. The spectral emission in the Ce doped crystals is in the blue-green region as compared with the emission in the blue region in undoped crystals. The trap depth and other parameters of the 120°C glow peak are estimated by the total curve fitting method.

30320 THERMOLUMINESCENCE IN CORRELATION STUDIES. Ratnam, V. V. (Indian Inst. of Tech., Kharagpur). pp 68-78 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Investigations on thermally stimulated processes have so far failed to give consistent results and hence could not be reliably used for determining the trapping parameters. The experimental simplicity of thermoluminescence (TL) advocates its use for the purpose but it has an inherent drawback in that it demands an apriori knowledge of recombination kinetics for using it for quantitative measurements. The glow curve by itself cannot give the order of kinetics because it is seldom that an experimental glow peak is pure. The credit of the photo-stimulated glow curve method is that it is a unique method for experimentally obtaining pure glow peaks and testing their purity as well. With the induction of reliability and quantitativeness to TL experimentation and the degree of sophistication achieved in recording glow curves, these curves can be used for correlation studies which are of concern to color centers. They are color center formation and destruction. By studying the optical bleaching behavior on the total glow curve and the individual peaks, the information obtained has been used to study the characteristics of color center destruction and their correlation with color center formation. Results reveal that correlation between formation and destruction does not exist at least in the initial stages of bleaching of F centers in x-irradiated KCl.

30321 LUMINESCENCE AND TRAPPING IN SrS:Bi PHOSPHOR WITH VARYING AMOUNTS OF FLUX. Awate, A. V.

(Shivaji Univ., Kolhapur, India); Jambagi, N. M.; Narlikar, A.V. pp 79-88 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Strontium sulfide phosphors doped with bismuth as an impurity have been prepared by varying amount of Li_2SO_4 as a flux. The amount of Li_2SO_4 was varied from 2.5 to 50% of the host lattice. To investigate the role of flux the phosphorescence and thermoluminescence have been studied for all samples. From the thermal glow peaks the activation energies were evaluated from initial rise method, Halperin and Branner method and Randall, Wilkins method which are in good agreement with those obtained by phosphorescence studies. From these studies it may be noted that the addition of flux does not create new traps but certainly affects the intensities of phosphors. This may be explained on the basis of imperfections produced during preparation.

30322 BLEACHING OF GAMMA INDUCTED TL WITH UV-RAYS IN PINK QUARTZ. David, M.; Nambi, K.S.V.; Ganguly, A. K. (Bhabha Atomic Research Centre, Bombay). pp 89-96 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Thermoluminescence (TL) in pink quartz can be sensitized by irradiation with gamma rays. It has earlier been observed that gamma induced sensitization could not be removed by heat treatments to the sample. Results of experiments on desensitization of gamma irradiated samples by UV-irradiation (predominantly 253.6 nm) are reported. It was found that desensitization occurs to a considerable extent, and all the glow peaks of gamma irradiated samples when subjected to the hard UV irradiation, become bleached from the lower to the higher temperature side of the glow curve.

30323 EFFECT OF Mn DOPING ON THE THERMOLUMINESCENCE OF CaF_2. Ratnam, V. V.; Banerjee, H. D. (Indian Inst. of Tech., Kharagpur). pp 104-110 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The thermoluminescence (TL) of undoped and Mn doped CaF_2 crystals is studied. Results indicate that like color center formation, wide divergencies exist in TL properties as well, which are related to temperature of irradiation and the type of ionizing radiation used (x-rays or cathode rays). In undoped crystals, while TL is observed with x-rays at all temperatures of irradiation up to 250°C, no TL is observed above 150°C when cathode rays are used. Mn doping inhibits TL emission even at lower temperatures −50°C in the case of 1% Mn and 100°C in the case of 5% Mn doped crystals respectively. Utilizing the information on the cathodoluminescence spectra and color center formation in Mn doped crystals, the TL behavior of these doped crystals is explained in the light of the present ideas of the understanding of the electronic properties of this system.

30324 GENERATION OF PURE THERMOLUMINESCENCE PEAKS BY PHOTOSTIMULATION. Gartia, R. K.; Ratnam, V.V. (Indian Inst. of Tech., Kharagpur). pp 111-118 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

By a proper selection of the temperature of x-irradiation and the time of F-stimulation a pure thermoluminescence (TL) peak at 131°C is generated in pure KCl. A pure TL peak enables not only a more accurate determination of the thermal activation energy (E) but also establishes the order of kinetics through its geometrical factor. The geometrical factor of 131°C peak shows that it follows second order kinetics. The theoretical TL peak is numerically computed using the equation of Garlick and Gibson for peak following second order kinetics with different values of E and $s'n_0$ (frequency factor) and the one with E = 0.78 eV and $s'n_0 = 1.3 \times 10^8$ (s^{-1}) is found to give the best fit with the experimental curve. Thermal activation energy of traps responsible for this peak, calculated by using Chen's formulas for general order kinetics yield values close to 0.78 eV. The peak around 260°C has been isolated by numerical curve fitting (using the equation of Randall and Wilkins) and through the difference curve, hidden peaks in the region 180 and 220°C have been observed. (auth)

30325 THERMOLUMINESCENCE OF RARE EARTH ACTIVATED $(Ba:Sr)SO_4$ AND $(Ba:Cd)SO_4$. Soudagar, M. K. (Rajaram Coll., Kolhapur, India); Narayana, K. L. pp 119-128 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The thermoluminescence (TL) of rare earth(RE) activated sulfates of (Ba : Cd) and (Ba : Sr) was studied above room temperature. When activated with cerium, the phosphors exhibited an extremely bright TL following x-irradiation. Their characteristic glow peaks were observed between 327 and 504°K. Instead of saturation of the TL intensity curve with x-irradiation dosage, double peaks have been obtained below an x-irradiation exposure time limit of 140 minutes in the case of $(Ba:Cd)SO_4$ lattice, while a single peak was found for $(Ba:Sr)SO_4$ corresponding to the x-ray dosage of 60 minutes irradiation. Thus the phosphors prepared are useful for TL dosimetry. Activation energies have been evaluated using four different theoretical models and the TL phenomenon has been discussed in terms of the various luminescence processes.

30326 THERMOLUMINESCENCE OF COPPER ACTIVATED KCl CRYSTALS. Murti, Y.V.G.S. (Indian Inst. of Tech., Madras); Murphy, K.R.N. pp 129-135 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The results of thermoluminescence studies on x-ray irradiated KCl and copper doped KCl crystals are reported. As-grown undoped crystals give a low intensity peak at 357°K. Two glow peaks at 381 and 460°K are recorded in quenched crystals. Copper doping gives rise to multiple overlapping glow peaks located at 360, 467, and in the region between 400 and 425°K. It was possible to isolate a single intense glow peak at 381°K by a pre-irradiation thermal treatment. The trap depth (E) and the frequency factor (P) of the 360, 381, and 450°K peaks are determined by fitting to a first order kinetics model for the thermoluminescence. A possible identification of the glow peaks to F-centers and Cu^+ ion centers is discussed.

30327 BASIC MECHANISM OF THERMOLUMINESCENCE IN ALKALINE EARTH SULFATE PHOSPHORS. Luthra, J. M.; Gupta, N. M.; Nambi, K. S. V.; Bapat, V. N. (Bhabha Atomic Research Centre, Trombay, India). pp 147-167 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Work on TL properties of alkaline earth sulfate phosphors with emphasis on the basic mechanism is reviewed. Work carried out at B.A.R.C., Trombay on different impurity doped $BaSO_4$ and $CaSO_4$ phosphors is emphasized. The correlation studies on TL, glow emission spectra, ESR, and optically excited luminescence have helped in identification of charge trapping centers, emission centers, and recombination sites. A mechanism has been discussed which can explain the TL behavior of the alkaline earth sulfate phosphors.

30328 THERMOLUMINESCENCE OF CaS:Pd PHOSPHORS. Lawangar, R. D. (Shivaji Univ., Kolhapur, India); Narlikar, A.V. pp 183-190 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

CaS phosphors doped with Pd in varying concentrations have been prepared and their thermoluminescence has been systematically studied in the temperature range of 300 to 530°K. The glow curves obtained for all samples exhibit two distinct peaks. The activation energies have been estimated in three different ways, and the escape frequency factor is determined using the theoretical model of Randall and Wilkins. The effect of addition of activator on general features of the glow curves and on distribution of traps is discussed. Conclusions are drawn regarding the type of kinetics involved in the thermoluminescence process.

30329 THERMALLY STIMULATED CURRENTS IN CaS:Bi:Pd PHOSPHORS. Lawangar, R. D. (Shivaji Univ., Kolhapur, India); Narlikar, A. V. pp 191-200 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Measurements of thermally stimulated currents (TSC) have been made on Cas : Bi : Pd phosphors as a function of temperature. Using different theoretical models the TSC curves obtained have been used to determine the trap depth E. The values thus ob-

tained are compared with those estimated from thermoluminescence (TL) studies of these phosphors and are mutually consistent. It is observed that though TSC curves and TL curves exhibit two peaks in the temperature range of 300 to 530°K, in TSC the ratio of peak intensity of the first peak to the second is smaller than that in TL curves. A possible explanation for this observed phenomenological difference is advanced.

30330 THERMOLUMINESCENCE (TL) STUDIES IN COBALT CHELATE: EFFECT OF DOPING WITH DIFFERENT IONS. Sen Gupta, S.; Shankar, J. (Bhabha Atomic Research Centre, Trombay, India). pp 201-209 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The effect of doping with different ions viz. Mn^{2+}, Nd^{3+}, Eu^{3+}, Fe^{2+}, Fe^{3+} and Co^{2+}, in various concentrations on the thermoluminescence in the cobalt complex $[Na(Co\ Hy^{-3}NO_2)H_2O]$ has been studied in detail. It is observed that sensitizers such as Mn^{2+}, Nd^{3+} increase the TL intensity very much, at the same time new peaks appear at high concentrations of the dopants. Killers such as Fe^{2+}, Fe^{3+}, Co^{2+} quench the TL. When the complex is doped with impurities likely to be present or formed during the method of preparation, viz. Co(III) EDTA, Co(II) EDTA, Na^+, or NO_3^-, the TL intensity is reduced in all the cases. The emission glow peaks (100 and 200°C) of the undoped complex are in the region 550 to 590 nm, while the Mn^{2+} doped complex shows a new peak at 150°C which lies in the region 600 to 650 nm. This may correspond to $^4G_{(T_1g)} {}^6S$ transition in Mn^{2+}. Nd^{3+} doped complex shows two peaks (130°, 173°C). These correspond to $^2H_{11/2} \rightarrow {}^4I_{9/2}$ and $^2G_{7/2,9/2} \rightarrow {}^4I_{9/2}$ transitions in Nd^{3+} impurity centers respectively.

30331 THERMOLUMINESCENCE (TL) STUDIES IN COBALT CHELATE: EFFECT OF DOPING WITH WATER. Sen Gupta, S.; Swarup, S. (Bhabha Atomic Research Centre, Trombay, India). pp 210-218 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Thermoluminescence (TL) studies have been carried out on water doped cobalt (III) complex $[Na(Co\ Hy^{-3})NO_2]H_2O$. Two glow peaks at 100 and 200°C have been observed in β^-, γ, and x-ray irradiated complex. On doping the complex with water the intensity of the first peak (100°C) is found to increase to a large extent while the second peak (200°C) vanishes completely. A number of experiments were carried to check the role of water in this system. To find out whether any structural change occurs in the lattice on doping with water, water doped as well as undoped complex was analyzed by ESR and x-rays powder diffraction technique. ESR spectra of the doped sample shows higher intensity than that of undoped one. In the x-ray powder pattern, the intensity of some of the lines in the doped samples is different from those in the undoped one. This indicates that there is a gradual structural change occurring during doping with water which is responsible for the enhancement of TL.

30332 GENERAL OBSERVATION OF THE TL PATTERNS OF CaF_2 AND KCl CRYSTALS. Rao, D. R. (Indian Inst. of Tech., Kharagpur). pp 248-253 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

By x-ray irradiation at 30°C it is in general observed that KCl crystals even in the purest form, have exhibited sufficiently intense glow peaks and coloration, whereas, for CaF_2 crystals the criterion for assessing their purity has been the negligible coloration and practically zero yield of TL. While Harshaw CaF_2 crystals are found to exhibit complex TL patterns for all temperatures of irradiation up to 150°C, such complexities are reduced for KCl crystals when they are irradiated above 150°C. By irradiating this way it has become possible to get a simple TL pattern for KCl crystals (grown from analar grade powders) and thereby the glow peaks could be resolved easily; an analysis of such a pattern indicated the values of E & S as 1.25 eV and 7.7×10^8/s respectively. But for CaF_2 crystals the TL output becomes very much reduced by increasing further the irradiation temperature beyond 150°C and the crystals have not exhibited in any case a simple TL pattern.

30333 THERMAL GLOW CURVES FROM QUENCHED PURE AND DOPED POTASSIUM CHLORIDE SINGLE CRYSTAL. Mukherjee, M. L. (Indian Inst. of Tech., Kharagpur). pp 254-261 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Thermoluminescence property of quenched potassium chloride, pure and doped with $PbCl_2$, has been studied. Quenching from 650°C enhances the glow output by a much larger amount than can be explained on the basis of enhancement of F-centers formation in quenched samples. Moreover, the glow peaks which are associated with divalent impurities and first stage of coloration are amply intensified due to quenching. Electrolytic coloration, which involves quenching, however, diminishes the integrated light output, when the colored crystal is exposed to x-rays and warmed up. These results have been explained on the basis of the fact that the recombination efficiency of electrons and holes can be changed by various pretreatment of the samples. A new peak in the glow curve of quenched has also been observed. (auth)

30334 THERMOLUMINESCENCE STUDY OF RARE EARTH DOPED $SrCl_2$. Sastry, M. D.; Dalvi, A.G.I.; Page, A.G.; Joshi, B. D. (Bhabha Atomic Research Centre, Trombay, India). pp 327-335 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Thermoluminescence (TL) glow curves of gamma irradiated $SrCL_2$ doped with Eu, Gd, Tb, and Am in trivalent form have been obtained in the temperature ranges 77 to 300 and 300 to 600°K. The glow peaks in the lower temperature (below 300°K) are accounted by the successive bleaching of V_k type trapped hole centers. Electron paramagnetic resonance (EPR) studies of Eu doped samples in the temperature range 300 to 550°K have been carried out in detail and the results strongly suggest that the TL glow peak around 510°K is followed by the trapping of electron by Cu^{3+} and the TL glow around 420°K is due to the thermal destruction of OH centers. The TL glow curves have been analyzed to obtain the trap depth and frequency factors.

30335 UV INDUCED THERMOLUMINESCENCE IN Mg_2SiO_4 (Tb). Bhasin, B. D.; Sasidharan, R. (Bhabha Atomic Research Centre, Trombay, India). pp 336-344 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Mg_2SiO_4 (Tb) is known for high sensitivity to gamma irradiation. Results of investigation of the UV induced thermoluminescence characteristics of the phosphor are reported. The UV irradiated glow curve shows a similar behavior to the gamma induced glow curve except that there is a minor shift in the peak temperatures. UV induced TL emission spectrum indicates that the emission center is Tb^{+3}. The dependence of TL excitation on the wavelength of exciting UV light is studied in the range of 200 to 300 nm. Higher wavelengths do not produce any TL. The sensitivity of the phosphor is compared with other phosphors reported in the literature. It is found that the phosphor is the most sensitive one to UV irradiation.

30336 SPECTRAL VARIATIONS IN THE TL EMISSIONS OF VARIOUS LiF PHOSPHORS. Nambi, K. S. V.; Bapat, V. N.; Rao, S. M. D. (Bhabha Atomic Research Centre, Trombay, India). pp 365-372 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

TL spectra at temperatures above room temperature were recorded after gamma irradiation of the order of 100,000 R for about forty different samples of LiF. The studies have been confined to laboratory grown LiF crystals with different dopants and starting materials. Spectra were recorded for different concentrations of the dopant for certain specific elements such as Mg, Ti, Dy, and Ca. Spectra were analyzed both prior and after 400°C annealing of the phosphors. It was found that there is considerable variation in the TL emission spectra depending upon the starting material and the dopant added. The emission spectrum consists of broad bands. The position and magnitude of the band is observed to be dependent mostly in the impurity added. In the case of Mg doped samples the highest band is at 415 nm and another band slightly less intense at 325 nm. When doped with Dy the samples exhibit a prominent band at 325 nm with weaker bands at 375 nm and 415 nm. Introduction of Ti along with Mg in the lattice enhances the emission in the 415 nm band.

30337 SPECIFICITY BETWEEN TRAPS AND RECOMBINATION CENTERS IN THERMOLUMINESCENCE PHENOMENON. Bhasin, B. D.; Sasidharan, R. (Bhabha Atomic Research Centre, Trombay, India). pp 373-388 of Proceedings of the National

Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

The thermoluminescence glow curves of TL phosphors are usually studied for the total light emitted. Monochromatic glow curves of some of the important TL phosphors such as TLD-100, TLD-200, CaF_2(Nat.), Mg_2SiO_4(Tb), and quartz are presented. It is observed that the spectral composition of various glow peaks is different in most of the cases. The isothermal decays of important spectral lines of emission from different glow peaks of Mg_2SiO_4(Tb) phosphor are also reported. The decay curves are almost parallel for 170 and 420°C glow peaks and are not parallel in the case of 300°C glow peak. A model is proposed to explain these results, implying specificity between traps and recombination centers. The model is consistent with other aspects of TL phenomenon. Basically it is envisaged that the defects acting as traps and recombination centers are not independently distributed. They exist in some sort of an ordered configuration generating potential TL units. These units as such are randomly distributed within the crystal. The degree of specificity depends upon the probability of capture of thermally released charge carriers within their individual TL units.

30338 EFFECT OF A PREPARATIVE PARAMETER ON THERMOLUMINESCENCE EFFICIENCY OF CaS:Bi PHOSPHOR. Vij, D. R.; Mathur, V. K. (Kurukshetra Univ., India). pp 546-552 of Proceedings of the National Symposium on Thermoluminescence and its Applications. Bombay; Bhabha Atomic Research Centre (1975).

From national symposium on thermoluminescence and its application; Kalpakkam, Madras, India (12 Feb 1975).

Calcium sulfide phosphor activated with Bismuth is a very bright phosphor which is equally efficient in thermoluminescence. However, its efficiency depends markedly on a number of preparative parameters such as the concentration of activator, flux, and temperature of firing. These parameters have already been investigated in detail. It was found that there is a new parameter i.e., rate of cooling of the charge after firing, which affects the thermoluminescence efficiency of the CaS:Bi phosphor which has not been reported so far. The fast-cooled sample is found to be more efficient in thermoluminescence than the slow-cooled sample. It appears that fast cooling results in freezing in of the defects which give rise to higher electron trap density and thereby increase its TL efficiency. (auth)

30339 DENSITY, SURFACE TENSION, AND VISCOSITY OF URANIUM TRICHLORIDE–SODIUM CHLORIDE MELTS. Desyatnik, V. N.; Katsyshev, S. F.; Raspopin, S. P.; Chervinskii, Yu. F. Sov. At. Energy (Engl. Transl.); 39: No. 1, 649-651(Jul 1975).

Translated from At. Energ.; 39: No. 1, 70-72(Jul 1975).

The density and surface tension were determined by measuring the pressure in Ar bubbles. The viscosity was measured by a method based on damped oscillations of a filament-suspended cylindrical crucible filled with the melt. The data are presented in tables and plots and discussed. (JRD)

30340 OPTICAL STUDY OF DEFECTS IN SILICON IRRADIATED WITH FAST NEUTRONS. Newman, R. C.; Totterdell, D. H. J. (Univ. of Reading, Eng.). J. Phys., C (London); 8: No. 22, 3944-3954(21 Nov 1975).

Crystals of silicon which were pure, and either monocrystalline or polycrystalline, or were doped with oxygen, or with carbon and oxygen have been irradiated at room temperature with fast neutrons to doses in the range 10^{15} to 10^{20} n^0 cm^{-2}. After irradiation, measurements were made of the strengths of the induced electronic absorption due to divacancies at 1.7 μm and that due to band tailing below the fundamental edge (γ - 1.05 μm) together with the vibrational one-phonon absorption below the Raman frequency ω_R (band mode) and intrinsic local-mode features just above ω_R. The strengths of all these features were correlated but were independent of the degree of crystal perfection and the presence of oxygen and carbon impurities. Annealing studies showed a major stage near 150°C when all the divacancies were lost; the anneal temperature decreased systematically with increasing n^0 dose and was reduced further in the polycrystalline samples, but was unaffected by the impurities. There were also large decreases in the strength of the edge- and band-mode absorption, but a residual 10% unannealed fraction did not disappear until 550 to 600°C, when other electronic bands disappeared. Measurements of the local mode absorption due to carbon have given no further information on the location of this light impurity following irradiation. (auth)

30341 ELECTRON SPIN RESONANCE IDENTIFICATION OF F CENTERS IN KCN. Letter to the Editor. Scavarda do Carmo, L. C.; Costa Ribeiro, S. (Pontificia Univ. Catolica, Rio de Janeiro). J. Phys., C (London); 8: No. 22, L527-L529(21 Nov 1975).

The identification of the F Center in KCN is reported. It is shown that a correlation exists between the EPR spectrum of the F center and the optical F band at 585 nm. (auth)

30342 DOSE DEPENDENCE OF ESR SPECTRA FOR ON-CHANNEL-IRRADIATED SILICON. Nakata, H. (Univ. of California, Los Angeles); Morishima, H. Phys. Status Solidi (a); 33: No. 2, 633-638(16 Feb 1976).

ESP spectra were observed at room temperature for silicon irradiated by 10^{12} to 10^{16} P^+ ions cm^2 at 190 keV in the ⟨111⟩ channel direction. Results show that the relation between the relative number of spins and irradiation dose is not monotonic but has structure in this dose region, and that the total number of spins relatively varies by a factor of only 10 in this region. (auth)

30343 OPTICAL PROPERTIES OF OXYGEN-IMPLANTED GaAs. Rao, E.V.K. (Centre National d'Etudes des Telecommunications, Bagneux, France). Phys. Status Solidi (a); 33: No. 2, 683-690(16 Feb 1976).

Optical properties of oxygen-implanted and annealed GaAs layers are investigated hoping to use them for near ir waveguiding. Multi-implanted layers with flat oxygen distributions are used for optical density versus incident photon energy measurements in order to find out the predominant mechanism, absorption and/or scattering, for near-band-edge attenuation. These measurements are carried out both with layers unannealed and annealed up to 520°C. In the case of unannealed samples, optical attenuation follows an exponential dependence on photon energy suggesting band tail states. Similar analysis in certain annealed samples showed a quadratic dependence on photon energy suggesting a non-negligible absorption in damaged regions of small size ($\approx$ 100Å). Since in general a great fraction of optically active defects get annealed around 500°C, and also since a high-temperature stable electrical compensation due to the presence of oxygen can be obtained, 1.15 μm waveguiding in O^+ implanted and high-temperature annealed GaAs seems to be possible. (8 fig.)

30344 DISLOCATION REACTIONS IN ARSENIC-IMPLANTED AND ANNEALED SILICON. Mader, S.; Michel, A. E. (East Fishkill Labs., Hopewell Junction, NY). Phys. Status Solidi (a); 33: No. 2, 793-805(16 Feb 1976).

Arsenic implantation into Si and annealing at 800°C creates a high density of small interstitial dislocation loops. Further annealing in the range of 900 to 1000°C causes coarser dislocation structures which depend on the initial implantation conditions. After implantation through thin SiO_2 layers, large winding dislocation loops of shear type are obtained. A detailed account is given of the transformation of small interstitial loops into large shear loops.

30345 COLOR CENTERS CONCENTRATION AND OPTICAL DENSITY DISTRIBUTION MEASUREMENTS IN NaCl MONOCRYSTALS IRRADIATED WITH X-RAYS. Gajewski, A.; Szaynok, A. pp 67-74 of Physical Properties of Dusts. Wroclaw; Politechnika Wroclawska (1973). (In Polish)

Irradiation of NaCl monocrystals with β-rays from Sr-90 causes the coloring of the crystal, as a result of F-center creation. The F-center concentration depends on the activity of the β-ray source and on the irradiation time. The measurements of absorption spectrum of NaCl monocrystal in dependence on irradiation time and activity of the source have been carried out by means of the spectrophotometer. With the microphotometer have been made the measurements of the optical density distribution in the NaCl monocrystals irradiated with β-rays for two irradiation times and two activities of the source. (auth)

30346 THE STATISTIC INTERPRETATION OF STUDIES ON ELECTRIFICATION OF A DUST FORMED FROM THE KCl MONOCRYSTALS IRRADIATED WITH X-RAYS. Wolniewicz, H. pp 31-38 of Physical Properties of Dusts. Wroclaw; Politechnika Wroclawska (1973). (In Polish)

Electric charges of particular particles of a pulverized substance are accidental and obey the probability calculus law. The standard deviation of a given normal distribution is a measure of electrification degree of a dust. The standard deviation σ_t obtained theoretically and s_e parameter obtained from measurements are different. Considering the electric conductivity of a substance in interpretation of results of studies on the dust electrization good agreement with the experiment can be obtained. (auth)

30347 THE ELECTRIC RESISTANCE OF THE KCl MONOCRYSTALS IRRADIATED WITH X-RAYS. Wolniewicz, H. pp 53-65 of Physical Properties of Dusts. Wroclaw; Politechnika Wroclawska (1973). (In Polish)

The electric resistance measurements of the KCl monocrystals are the part of the detailed studies on the influence of a lattice defect of type center F formed by X-rays on the charge distribution in a dust cloud. The applied energies of the monochromatic X-ray radiation were corresponding with the voltage on a lamp, equal 40, 50, and 60 kV at current strength 8 mA. Irradiation time was 1, 3 and 5 hours for each voltage, respectively. (auth)

30348 RADIATION DEFECTS RESEARCH IN SINGLE CRYSTALS OF LITHIUM NIOBATE. Antonov, V. A.; Arsenev, P. A.; Baranov, B. A.; Barinova, N. D.; Kustov, E. F.; Linde, I. G. (Moskovskij Ehnergeticheskij Inst. (USSR)). Krist. Tech.; 9: No. 12, 1403-1410(1974).

Information is given on the kinetics of developing ionization defects by γ-radiation, as well as on the destroying of these defects as a result of thermal treatment in oxidizing atmosphere at different temperatures. The presence of several types of ionization defects developed by γ-radiation is found out. Values of diffusion factor for each type of defects are given. (INIS)

30349 WHAT IS RADIATION CURING. Kinstle, J. F. Met. Finish.; 73: No. 7, 36-40(Jul 1975).

A survey of radiant energies throughout the electromagnetic spectrum shows that electron beam and ultraviolet energies are most useful for the conversion of liquid to solid coating, the final choice depending on particular requirements. Basic concepts of polymer coatings and radiation chemistry applied to curing processes are delineated. High-energy, ultraviolet, infrared, microwave, glow discharge, and gaseous plasmas are described, noting reactions they initiate and how these can be utilized for polymerization. Rate of polymerization is equated to variables which can be controlled by choice and concentration of polymers and energy density. Some cost factors in the choice of energy source are indicated. (Metals Abstr.)

30350 THERMOLUMINESCENCE OF FUSED QUARTZ IRRADIATED WITH CHARGED PARTICLES. Shekhmametev, R.I.; Por, G. Opt. Spectrosc. (USSR) 39: No. 5, 564-565 (Nov 1975).

The thermoluminescence of quartz irradiated with 14-MeV alpha particles from the cyclotron of A. F. Ioffe Physico-technical Institute is reported. For a comparison the x-ray irradiated TL of quartz is also given.(AIP)

30351 ON THE EFFECT OF NEUTRON IRRADIATION OF THE SEED ON THE ELECTROPHYSICAL PKOPERTIES OF TRIGLYCINESULPHATE. Evseev, I.I.; Kamysheva, L.N.; Milovidova, S.D.; Kovalenko, A.N.; Borodulin, L.A. (Voronezh State University). Sov. Phys.—Crystallogr. 20: No. 5, 653-654 (Sept 1975).

The effect of irradiation of the crystal seed on the properties of the crystal grown from it. The ferroelectric crystal triglycinesulfate TGS $[NH_2CH_2COOH)_3H_2SO_4]$, the properties of which have been thoroughly studied was chosen as the object of investigation. (AIP)

30352 RADIATION EFFECTS IN LiF SINGLE CRYSTALS IRRADIATED BY NEUTRONS AT LOW TEMPERATURES. Telegina, I.V.; Kolontsova, E.V. (M. V. Lomonosov Moscow University). Sov. Phys.—Crystallogr. 20: No. 5, 654-655 (Sept 1975).

Single crystals of lithium fluoride were bombarded with neutrons in the low-temperature channel of a reactor at ~100°K and integrated doses of $10^{17}-10^{18}$ n/cm^2 (relative to fast neutrons). The diffuse scattering method (monochromatized MoKα radiation) for successive sections of the reflection sphere for the space of the reciprocal latice, as well as the small-angle scattering of x rays, which is necessary for a more unambiguous interpretation of the diffuse-scattering was used. In parallel we studied crystals irradiated with $10^{17}-10^{18}$ n/cm^2 under the usual heat dissipation conditions for analogous neutron fluxes (10^{12} n/cm^{2}sec). (AIP)

30353 SIMULATION OF STRATOSPHERIC BALLOON ENVIRONMENT. Sable, C. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 31 - Toulouse (France). Centre d'Etudes et de Recherches). pp 561-566 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974). (In French)

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

The behavior of materials used for the construction of stratospheric balloons is studied at DERTS by means of irradiations performed in real time and simulating the exact flight environment. Two chambers were designed in the laboratory and are described together with the experimental procedure. In order to reduce cost and save time, it is worth accelerating the simulation when only a preliminary evaluation of the sample's properties is required. For this reason, a systematic study was undertaken in order to evaluate the respective effects of different parameters on the material degradation. The results of this study are given. (FR)

30354 MBB SPACE RADIATION SIMULATION TEST FACILITY: PERFORMANCE DATA AND IN SITU EVALUATION OF THE OPTICAL DEGRADATION OF SSM UNDER ULTRAVIOLET AND PROTON IRRADIATION. Husmann, O. K. (Messerschmitt-Boelkow-Blohm G.m.b.H., Muenchen (F. R. Germany)). pp 135-151 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

A solar radiation simulation test facility has been developed. This facility employs an ultrahigh vacuum system to avoid surface contaminations. The rotatable sample holder can carry twenty samples of the size 2 × 2 cm. Four of these samples may be irradiated simultaneously. Each of five sample holder segments can be heated independently, or the entire sample holder may be cooled. Radiation simulation incorporates solar radiation up to ten solar constants at the sample and particle intensities up to 10^{12} H_1^+/cm^2 sec. The wave length dependent sample reflectance can be checked in situ within the range from 2400 Angstroms to 2.5 microns. A few second surface mirrors (SSM) have been tested with this equipment, concerning the degradation of their solar absorption coefficients. (FR)

30355 BEHAVIOR OF CARBON FIBRE COMPOSITES UNDER SIMULATED SPACE ENVIRONMENT. von Bassewitz, H. (Messerschmitt-Boelkow-Blohm G.m.b.H., Muenchen (F. R. Germany)). pp 525-537 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

MBB is developing an ultra lightweight solar array for telecommunication spacecrafts in the power range of 5 to 10 kW. The array structure consists of carbon fiber reinforced plastics, a material of which the behavior under space conditions has been investigated in more detail. This compound material has been accepted by ESTEC for space application and will be used in the OTS solar array. CFRP samples have been exposed to different radiation modes (UV, electrons, protons) and subjected to thermal shocks to find out possible degradations of mechanical properties such as stiffness and strength. Conditions of a 10 years lifetime in a synchronous orbit have been simulated where possible. The simulated space environment caused a property change in the range of 13% improvement down to 28% degradation. Where accelerated tests with higher radiation intensities (up to factor 10) have been applied, the measured degradation is more pronounced than it will be under orbit conditions.

30356 LOW ENERGY ELECTRON SPECTROSCOPY APPLIED TO SURFACE STUDY. Lecante, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Atomique). pp 137-212 of Current Methods for Studying Gas-Surface Interactions. Meeting Organized by the Centre d'Actualisation Scientifique et Technique, Lyon, 6-7 February 1973. Lyon, France; Institut National des Sciences Appliquees (1973). (In French).

From meeting on current methods for studying gas-surface interactions; Lyon, France (6 Feb 1973).

Electron spectroscopy covers the energy analysis of electrons emitted by solid and gaseous targets as a result of bombardment with various particles (photons, electrons, ions, and neutral or excited atoms) or as a result of the action of a strong electric field. Excitation and de-excitation processes undergone by the atoms are discussed. The different physical properties obtained from electron spectroscopy are examined.

30357 IN SITU MEASURING FACILITY FOR EVALUATING AND PERFORMING ACCELERATED DEGRADATION TESTS FOR THERMAL CONTROL COATINGS. Weingaertner, I.; Swoboda, H. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Braunschweig (F. R. Germany)). pp 539-547 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

A combined environment test facility was constructed providing a wide range of ultraviolet (UV) radiation, low energy proton irradiation, electron irradiation, neutral gas and volatile condensable material (VCM) for materials investigation in a clean, oil-free high vacuum. A xenon lamp equipped with appropriate filters and a hydrogen discharge lamp irradiate the samples, simulating the solar ultraviolet and visible light up to about 30 solar constants. The solar wind simulator consists of the electron ionization proton sources, accelerator, ion separator, and beam current detector. The energy of the protons can be

raised to 5 keV and the proton flux by three orders of magnitude above the average densities in near-earth orbits. The diameter of the samples is 45 mm, the temperature of the samples is controlled. The reflectance of the samples is measured in situ before and after exposure to combined UV and particle irradiation by a spectrophotometer up to wavelengths of 40 μm. Furthermore the combined influences of VCM, UV, low energy protons, and electrons on the thermal control coating degradation can be tested.

30358 TECHNOLOGICAL FACTOR DEPENDENCE OF THE CHARACTERISTICS OF A MICROWAVE TRANSISTOR (2.5 GHz) COMBINING DIFFUSION AND IMPLANTATION. Assemat, J. L.; Dumetz, A.; Wattremez, J. M.; Lagorsse, J. M. (Lignes Telegraphiques et Telephoniques (LTT), 78–Conflans-Sainte-Honorine (France)). pp 150-154 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French).

From fourth international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces no. 171.

Transistors made by boron implantation in the base, and arsenic implantation and/or diffusion in the emitter are discussed. For a given emitter and a given technology (implanted or diffusion doped emitter), it has been verified that the gain and microwave performance could be controlled by varying the implantation conditions for the base (energy and dose). For a given implanted base, the transistor characteristics are the same in the two cases, but it is easier to make emitters using solid-solid diffusion.

30359 ACCUMULATION LAYERS AT THE INTERFACE BETWEEN SEMICONDUCTING AND INSULATING LAYERS OBTAINED FROM IONIZED MEDIA. Pompei, J. (La Radiotechnique Compelec (RTC), 92–Suresnes (France)). pp 239-247 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French).

From fourth international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces no. 171.

Results of a phenomenological study of electronic properties of semiconducting thin layers obtained by synthesis with reaction sputtering and coated or not with a dielectric thin layer deposited by ionic processes are exposed. Resistive behavior of thin-film structures on insulating substrate M/S (Metal/Semiconductor) and M/S/I (Metal-semiconductor-Insulator), where S means ZnO and I polytetraethoxysilane (P/T.E.S.) or polytetrafluoroethylene (P.T.F.E.), versus relative humidity was studied. Very high sensitivity M/S/I devices, provided with accumulation layers may be used like hydrometric probes.

30360 EVOLUTION IN THE CONFIGURATION OF ETCHING MASKS UNDER IONIC EROSION. Ducommun, J. P.; Cantagrel, M.; Moulin, M. pp 256-262 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French).

From fourth international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces no. 171.

A mathematical model for predicting the evolution of any profile under ion erosion is proposed. Experimental evidence and usage of the model in mask etching are discussed.

30361 ANALYSIS OF As IMPLANTATION PROFILES IN SILICA BY NUCLEAR MICROANALYSIS AND SECONDARY ION EMISSION. Dieumegard, D.; Croset, M. (Thomson-CSF, Domaine de Corbeville, 91–Orsay (France)); Cohen, C.; Lhoir, A.; Rigo, S. (Ecole Normale Superieure, 75–Paris (France). Groupe de Physique des Solides); Chaumont, J. (Centre National de la Recherche Scientifique, 91–Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). pp 263-269 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French).

From fourth international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces no. 171.

Results obtained from analysis using either the method of elastic backscattering of light or semi-heavy ions ($^4He^+$, $^{14}N^+$) about one MeV energy or the secondary ion emission method are compared. The choice of As implanted Si is explained by the following reasons: As is an element relatively heavy in comparison with Si, that allows an analysis to be effected on a few thousands Angstroems depth in silica using elastic backscattering; the silica chosen as substrate being an amorphous material allows channeling phenomena to be avoided during implantation and analysis.

30362 USE OF ION IMPLANTATION FOR CREATING A P WELL IN N SILICON: REALIZATION OF COMPLEMENTARY TRANSISTORS. Garcia, M.; Piaguet, J.; Roussin, J. C.; Guernet, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique); Gilles, J. (Thomson-CSF, 75–Paris (France); Societe Europeenne des Semiconducteurs et Microelectroniques (SESCOSEM), 75–Paris (France)). pp 278-284 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French).

From fourth international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces no. 171.

Circuits involving complementary MOS transistors were obtained by simultaneously realizing P and N MOS transistors on the same substrate from predeposition by ion implantation.

30363 MATHEMATICAL MODELS OF ION IMPLANTATION. Combasson, J. L. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). pp 321-328 of Electron and Ion Beam Processes Applications. 4. International Congress AVISEM 74. Toulouse, October 8-11, 1974. Paris, France; Societe Francaise du Vide (Oct 1974). (In French).

From fourth international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974). Supplement to the journal Le Vide les Couches Minces no. 171.

For several years, ion implantation in semiconductors have allowed remarkable results to be obtained, especially in MOS transistor field. Tables for defining implantation conditions are commonly used in order to delineate the physical parameters involved in implanted circuits fabrication. Hypotheses involved in calculating impurity profiles and energy loss are given.

30364 MICROSTRUCTURAL OBSERVATION OF GRAPHITE MATERIALS. Kimura, S. (Tokyo Inst. of Tech. (Japan). Research Lab. of Engineering Materials). Tanso; No. 78, 95-104 (Jul 1974). (In Japanese).

The optical microscopic and electron microscopic observation of the structure of graphite materials are reviewed according to the papers presented in the last several years. The review is classified into seven items, namely 1) stream structure, 2) mesophase, 3) polycrystalline graphite materials, 4) influence of hot press, 5) pyrolytic carbon, 6) glassy carbon, and 7) composite of carbon fiber and carbonaceous materials. (INIS)

30365 SIMULATING THE TIME OVERLAP OF HEAVY, CHARGED-PARTICLE TRACKS BY PERIODIC IRRADIATION OF IONIC CRYSTALS WITH NANOSECOND PULSES OF VERY STRONG, ELECTRON BEAMS. Vaisburd, D. I.; Kuznetsov, V. P.; Moskalev, V. A.; Shafir, M. M. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 118-119 (1975). (In Russian).

Single crystals of sodium fluoride were irradiated with 3.5 MeV protons, and the concentration of radiation defects (F-centers) was determined as a function of the concentration of proton tracks. Crystals of potassium chloride were also irradiated by pulse packets following each other with a fixed period T at a pulse duration of 5 ns and beam current amplitude of 140 A/cm^2. A comparison of the two irradiations showed that the buildup of radiation defects was similar in both instances. It was possible to determine the yield of defects per pulse at the linear stage of defect accumulation and the saturation level for the fast stage of defect accumulation, which occurs after three pulses. (SJR)

30366 TARGET HEATING DURING ION IMPLANTATION. Parry, P.D. (Western Electric Engineering Research Center, Princeton, New Jersey 08540). J. Vac. Sci. Technol. 13: No. 2, 622-629 (Mar 1976).

The temperature of ion-implanted silicon wafers has been measured as a function of time using an infrared pyrometer. Ion beam power density was varied from 0.10 to 200 W cm^{-2}, and the target temperature was measured in the range from 100°C to the silicon melting point. The resulting heating and cooling curves have been analyzed using a model which includes the effects of ion beam heating, radiative cooling, conductive cooling, and reradiation from the surroundings. For the system studied, conductive cooling in vacuum is less reliable and generally less effective than radiative cooling, unless conductive grease can be used. The model has also been generalized to the case of a group of wafers being scanned cyclically by the ion beam, and the

calculated temperatures have been compared with experimentally measured values. Implanting N wafers cyclically is not equivalent to dividing the input power density by N, because the time required for the wafers to cool is typically less than the time between scans. However, it is possible to reduce the wafer temperature by many hundreds of degrees by choosing the scan rates properly. The model is intended as a guide to the design of new apparatus as well as to the use of existing ion implantation systems. Although silicon is used in the examples, the procedure can easily be generalized to other target materials. (auth)

30367 MULTIPHONON-ASSISTED ANTI-STOKES AND STOKES FLUORESCENCE OF TRIPLY IONIZED RARE-EARTH IONS. Auzel, F. (Centre National d'Etudes des Télécommunications, 196 rue de Paris, 92220 Bagneux, France). Phys. Rev. B 13: No. 7, 2809-2817 (1 Apr 1976).

Experimental demonstration of multiphonon-assisted anti-Stokes and Stokes excitation of rare-earth ions (R^{3+}) in different hosts, that is, in a weak-coupling ion-lattice interaction case, is obtained. An exponential behavior of excitation probabilities with respect to energy difference between excitation and electronic line is found, just as for multiphonon-assisted nonradiative decay and energy transfer. Exponential parameters α_{AS} and α_S for anti-Stokes and Stokes excitation are measured and linked to the Miyakawa-Dexter α parameter for decay, leading to estimates for Pekar-Huang-Rhys coupling parameter S_0 of about 0.04, in agreement with values obtained from one-phonon spectra or nonradiative-decay measurements. A semiempirical formula is deduced to obtain α from only one parameter, an effective phonon energy. (auth)

30368 TRITIUM PERMEATION THROUGH MATERIALS FOR STEAM GENERATOR SYSTEMS. Bell, J. T.; Strehlow, R. A.; Redman, J. D.; Smith, F. J.; Savage, H. C. (Oak Ridge National Lab., TN). Conf. Remote Syst. Technol., Proc.; 23: 64-68(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

Mixed-isotope techniques and experimental apparatus have been developed for determining the rates of tritium permeation through metals at high temperatures. These methods are used primarily for observing the permeabilities of tritium through materials for steam generator systems. The techniques include the option of an inert gas or a controlled steam oxidizing atmosphere on the downstream side of the sample. Therefore, effects of surface oxidation and the formation of oxide coatings to impede tritium permeation can be determined. The validity of the method was demonstrated by determining the tritium permeability of nickel and comparing the tritium values with established hydrogen and deuterium permeabilities. The methods were applied in a long-term experiment by measuring tritium permeation through Incoloy 800 at 657°C with the downstream side of the sample continuously treated with a 750-torr sweep gas of Ar–H_2O with the H_2O partial pressure at 240 torr. Oxidation of the metal to form an oxide coating on the metal was accompanied by a decrease in the tritium permeation by a factor of 160 over a period of 84 days.

30369 WELDING PLASTICS BY THE NEUTRON CAPTURE PROCESS. Anno, J. N. (Univ. of Cincinnati). Nucl. Technol.; 29: No. 1, 124-126(Apr 1976).

Specimens of polymethylmethacrylate were welded by the neutron capture process using the ^{10}B isotope. In general, very weak bonds were obtained, of the order of a 20-psi bond strength for naturally enriched boron. Bond strength increased with thermal-neutron fluence to 10^{15} n/cm^2. At higher fluences the strengths decreased and the specimens became very brittle, presumably from radiation damage by the fast neutrons and gamma rays present in the radiation field of the reactor. Comparison of experiment with theory suggests that only a small fraction of the interface area is being welded.

30370 INVESTIGATION OF THE MAGNETIC PROPERTIES OF THE PHASES MVF_3 (M EQUALS Na, K, Rb). Cros, C.; Feurer, R.; Pouchard, M. (Univ., Bordeaux, Talence, France). Mater. Res. Bull.; 11: No. 2, 117-124(Feb 1976). (In French).

The magnetic properties of $NaVF_3$, KVF_3, and $RbVF_3$ have been investigated. According to previous expectations an antiferromagnetic behavior has been pointed out and the ordering temperatures have been defined. The results are interpreted on the basis of a Heisenberg model. For KVF_3 and $RbVF_3$ of perovskite structure the exchange integrals involve strong antiferromagnetic interactions. For $NaVF_3$, with a $GdFeO_3$ structure, an important weakening of the interactions and a ferromagnetic component are observed.

30371 EXPERIMENTAL INVESTIGATION OF THE CONCENTRATION DEPENDENCE OF THE THERMODIFFUSION FACTOR FOR H_2–He AND N_2–N_2O MIXTURES. Shashkov, A. G.; Zolotukhina, A. F.; Abramenko, T. N. (AN Belorusskoj SSR, Minsk. Inst. Teplo- i Massoobmena). Inzh.-Fiz. Zh.; 27: No. 4, 655-659(Oct 1974). (In Russian).

For English translation see the journal J. Eng. Phys.

30372 MELTING DIAGRAMS OF TERNARY SYSTEMS CONTAINING SODIUM AND POTASSIUM CHLORIDES, THORIUM TETRACHLORIDE, AND PLUTONIUM TRICHLORIDE. Desyatnik, V. N.; Vorobei, M. P.; Kurbatov, N. N.; Kalashnikov, I. S.; Skiba, O. V. Sov. At. Energy (Engl. Transl.); 38: No. 3, 219-221(Mar 1975).

Translated from At. Energ.; 38: No. 3, 173-174(Mar 1975).

Melting and phase diagrams are presented for $ThCl_4$–NaCl–$PuCl_3$ and $ThCl_4$–KCl–$PuCl_3$ systems. (JRD)

30373 BEHAVIOR OF FLUOROPLASTIC-4 UNDER THE EFFECTS OF NITROGEN TETRAOXIDE AND GAMMA RADIATION. Semerikova, I. A.; Sukhotin, A. M.; Rossomakho, G. A.; Yanochkin, N. P.; Shuvalova, V. G.; Tikhomirova, N. S.; Korableva, L. E. (State Inst. of Applied Chemistry, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 32-36(1975). (In Russian).

The kinetics of swelling of fluoroplastic-4 in N_2O_4 in liquid and gaseous phases has been studied between 20 and 50°C. Equilibrium swelling of fluoroplastic-4 at 50°C was obtained on 18–20-th day was found to be 3.6–3.7%. Radiation resistance of fluoroplastic-4 in liquid nitrogen tetroxide is in accordance with a change of swelling degree and mechanical properties. Swelling of fluoroplastic-4 in N_2O_4 practically does not depend on time of keeping in medium. Fluoroplastic-4 at irradiation as well as in air has low radiation resistance. Its mechanical properties fall 50% with respect to initial ones at the dose of 0.3–0.4 Mrad.

30374 EFFECT OF ATMOSPHERIC OXYGEN ON THE ELECTRICAL CONDUCTIVITY OF IRRADIATED POLYETHYLENE. Zavadovskaya, E. K.; Ar'yanov, A. P.; Antipin, G. P. (Tomsk Polytechnical Inst., USSR). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 4, 312-314(1975).

Translated from Khim. Vys. Energ.; 9: No. 4, 361-363(1975).

This experimental test confirmed the suggestion that electrons are captured by free radicals in irradiated polyethylene at room temperature. A 0.2-mm-thick polyethylene film was irradiated, and then vacuum treated while subjected to applied voltage until a given electric conductivity was reached. Air was admitted, and then the electric conductivity was measured. The conductivity increased after air admission at a rate dependent on irradiation dose and dose rate. The kinetics of the conductivity change was determined by the rate of air diffusion into the sample. (DDA)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

30375 (SRO-TWM-75-1) PLAN FOR THE MANAGEMENT OF RADIOACTIVE WASTE, SAVANNAH RIVER PLANT. (Energy Research and Development Administration, Aiken, S. C. (USA). Savannah River Operations Office). Jul 1975. 71p. Dep. NTIS $4.50.

The following areas are covered in the Savannah River Plant's radioactive waste management plan: program administration; description of waste generating processes; waste management facilities; radioactive wastes stored; plans and budget projections; and description of decontamination and decommissioning. (LK)

Accountability and Safeguards

Refer also to abstract 29357.

30376 IS THERE A PLUTONIUM PROBLEM. Stoll, W. (Alpha Chemie und Metallurgie G.m.b.H. (ALKEM), Grossauheim (F. R. Germany)). Atomwirtsch., Atomtech.; 20: No. 9, 419-423 (Sep 1975). (In German)

From reactor conference; Nuernberg, F. R. Germany (8 Apr 1975).

The plutonium problem, which has become one of the favorite subjects of discussion within the nuclear controversy, includes a number of fundamental contradictions whose explanation seems to be urgently required. Plutonium, a material involving extreme potential hazard, in the 32 years since its discovery has been produced in large quantities mainly for military purposes and in this process has not always been handled in accordance with our present knowledge and present possibilities of radiation protection. On the contrary, large quantities of it were deposited on the ground as a consequence of nuclear bomb tests. Yet, nobody has as yet been proven to have been injured as a result of the incorporation of plutonium. Plutonium as a "bad word" has a negative impact on the public which can hardly be surpassed. And yet, a whole coming generation of breeder reactors depends on the intentional multiplication of this material. These contradictions are explained in detail and elucidated by the results of various studies. The safest place for the plutonium produced in a reactor, at any rate, again is a reactor. Only by an accelerated circulation in the external fuel cycle can the relation between the amount of plutonium in circulation and the amount of energy to be generated said to be within tolerable limits. (DE)

30377 IMPROVEMENT OF SAFEGUARDS IN PLUTONIUM FUEL RECYCLING. Smiley, S. H. (Nuclear Regulatory Commission, Washington, DC). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 65-69(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Objectives and present status of two safeguards studies undertaken by the Nuclear Regulatory Commission (NRC) are discussed. Fixed site physical security elements being evaluated are listed. Measures being considered to protect nuclear materials in transit are given. (JGB)

Disposal and Storage

Refer also to abstract 28629.

30378 (AERE-R-8111) RADIOACTIVE WASTE DISPOSAL BY UKAEA ESTABLISHMENTS DURING 1974 AND ASSOCIATED ENVIRONMENTAL MONITORING RESULTS. Flew, E. M. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Oct 1975. 17p. Dep. NTIS $3.50.

This report gives details of the amounts of solid and liquid radioactive waste disposed of by the principal establishments of the UKAEA during 1974. Waste arising at the UKAEA Reactor Development Laboratory at Windscale and Reactor Fuel Element Laboratory at Springfields, which are both situated on British Nuclear Fuels Ltd. (BNFL) sites, is disposed of through BNFL and included in their authorizations. Discharges to atmosphere of gaseous radioactive waste from all UKAEA establishments have been far below the working limits agreed with the Authorizing Departments, and further details are not included in this report. A summary of the results of the environmental monitoring programmes carried out in connection with the radioactive waste discharges and disposal is given. The principles underlying the control of the discharge of radioactive waste to the environment are summarized in an Appendix to the report. (UK)

30379 (INIS-mf) RADIOACTIVE WASTE SEA DISPOSAL PRACTICES AND THE NEED FOR INTERNATIONAL REGULATIONS. Reyners, P. (Nuclear Energy Agency, 75-Paris (France)). 1975. 29p. (In French). INIS.

From colloquium on nuclear law and law of the sea; Paris, France (12 Jun 1975).

Colloquium organized by the Centre d'Etudes et de Recherches de Droit International and the Centre d'Etudes du Droit de l'Energie Atomique.

Radioactive waste is mainly disposed of as liquid releases in coastal waters or as solid wastes dumped in the high seas. The Geneva Convention on the high seas which lays down that Contracting States should not, by unilateral measures, pollute the seas by dumping radioactive wastes, and Article 37 of the Euratom Treaty on the Commission's control over radioactive waste disposal plans by Member States constitute the principal legal basis for such activities at international level. The competent international organisations, IAEA and the OECD Nuclear Energy Agency (NEA), have both made detailed studies on the scientific, technical and legal aspects of sea disposal of radioactive wastes. Following consideration of the possibilities of waste dumping in the Atlantic and the related hazard assessment, at its Member State's request, NEA in 1967 undertook an initial experimental packaged waste disposal operation in the high seas. This operation's technical success encouraged Member States to undertake further operations in subsequent years under NEA international control. At present, in view of the entry into force of the London Convention on prevention of marine pollution by dumping of wastes, it seems desirable that the international character of such operations be preserved and all countries concerned be encouraged to adopt an international code of practice for sea disposal of radioactive wastes. (FR)

30380 (NP-20834) IMPROVEMENTS NEEDED IN THE LAND DISPOSAL OF RADIOACTIVE WASTES: A PROBLEM OF CENTURIES. Report to the Congress by the Comptroller General of the United States. (Nuclear Regulatory Commission, Washington, D. C. (USA)). 12 Jan 1976. 57p. NRC.

Large volumes of other than high-level radioactive wastes, including some that are long lived and highly toxic, are disposed of at six licensed commercial and five principal Federal facilities in the United States. Some of these sites have been operating for more than 30 years, yet, it is not known what mix of hydrogeological characteristics and engineering features offers the greatest assurance that radioactivity, once disposed of, will not create a possible public health hazard. The report shows the need for a comprehensive study of existing disposal sites, the development of site selection criteria, and other efforts to improve program management and regulation of disposal sites. (auth)

30381 (TRG-Report-2680(S), pp 10-14) RADIATION DAMAGE IN FISSION PRODUCT STORAGE GLASSES. Marples, J. A. C.; Harper, E. A.; Hudson, B. (Atomic Energy Research Establishment, Harwell, Eng.). Sep 1975.

From 22nd UKAEA diffraction analysis conference; Dounreay, United Kingdom of Great Britain and Northern Ireland (UK) (15 Oct 1974).

In role of diffraction and electron analysis in the fast reactor programme. (UKAEA Reactor Group, Springfields).

It is shown that the biggest contribution to the damage in glass containing highly active waste is by α-decay. For the 46 SiO_2-7.5 Na_2O-7.5 Li_2O-20 B_2O_3-19 waste glass, no effect is observed at RT and 100°C even for doses > 1 dpa. At 200 to 600°C, bubbles form at doses > 8×10^{21} displacements/ml. This effect is independent of dose rate. Bubbles formed at 300°C enlarge when the temperature is raised to 600°C. Indications are that Li has a particularly deleterious effect. (DLC)

30382 (TRG-Report-2680(S), pp 14-16) PREPARATION OF GLASS SPECIMENS FOR THE HIGH VOLTAGE MICROSCOPE. Harper, E. A. (Atomic Energy Research Establishment, Harwell, Eng.). Sep 1975.

From 22nd UKAEA diffraction analysis conference; Dounreay, United Kingdom of Great Britain and Northern Ireland (UK) (15 Oct 1974).

In role of diffraction and electron analysis in the fast reactor programme. (UKAEA Reactor Group, Springfields).

The composition of the glass materials has been decided by properties such as creep, fission product retention, and moldability. The steps in preparing the samples for electron microscopy are described: disc formation, polishing, ion-beam thinning. (DLC)

30383 NUCLEAR WASTE DROP IN THE OCEAN. Turner, N. New Sci.; 68: No. 973, 290(30 Oct 1975).

The Nuclear Energy Agency (NEA) supervises the regular dumping of solid low-activity wastes, concreted, bituminized, and packed in metal drums in northeast Atlantic ocean. In 1972 the London Convention on the Prevention of Marine Pollution from Dumping of Wastes and Other Matter covered all types of pollutant, radioactive and chemical, though the specific recommendations for the application of the Convention were adopted only last year by IAEA. Not all the nuclear waste-producing countries have ratified the London Convention, nor do they abide by NEA rules and indiscriminate dumping still goes on. However, strict rules, which are here summarized, surround disposals carried out under NEA supervision. These include the design and construction of waste containers, choice of appropriate ships, and radiological safety of the crew. (UK)

30384 FIXATION OF HIGH LEVEL NUCLEAR WASTE IN GLASS FOR ULTIMATE DISPOSAL. I. General Aspects. Mukerji, J. (Central Glass and Ceramic Research Inst., Calcutta (India)). J. Sci. Ind. Res.; 33: No. 8, 397-405(Aug 1974).

After dealing with the various aspects of radioactive waste disposal, such as classification of radioactive wastes based on the level of activity, methods of their disposal, characteristics of wastes produced in reprocessing of different types of spent nuclear fuels, and fission products present in the wastes, the advantages and disadvantages of various methods of containment of high level wastes are discussed. The advantages of fixation of wastes in a glassy matrix are discussed in detail and the work done at the Central Glass and Ceramics Research Institute (CGCRI), Calcutta, for fixation of high level liquid wastes of fuel reprocessing plants is reported. Three major problems encountered in this connection are: (i) development of suitable glass compositions for containment of high level Purex wastes, (ii) prevention of release of fission products, especially ruthenium and cesium, under process conditions, and (iii) effect of heat and radiation on glass properties. The approach adopted and methods developed to solve each of these problems are briefly described. A flowsheet of the proposed glass fixation plant at Tarapur, India, is also given. (INIS)

30385 FIXATION OF HIGH LEVEL ATOMIC WASTE IN GLASS FOR ULTIMATE DISPOSAL. II. Development of Vitreous Matrices for the Containment of CIRUS, Tarapur and Rana Pratapsagar Nuclear Fuel Reprocessing Wastes. Sanyal, A. S.; Mukherji, J. (Central Glass and Ceramic Research Inst., Calcutta (India)). J. Sci. Ind. Res.; 33: No. 9, 436-460(Sep 1974).

The results of a study of various vitreous matrices for the incorporation of Purex wastes generated in India are presented. The melting behavior of the matrices, the long time extraction of fission products by various attacking agents, and the physical and chemical properties of the matrices are given. The study has been made in such a way that the compositional diagrams presented should help in formulation of vitreous matrices for the containment of Purex wastes of a wide range of compositions. Both silicate and phosphate glasses have been studied and the factors affecting the selection of glass compositions for the containment of nuclear wastes have been discussed. (auth)

30386 TOXIC AND RADIOACTIVE SOLID WASTES. Lewis, J. B. (Univ. of Nottingham, Eng.). pp 185-193 of Course on the Recycling and Disposal of Solid Waste. Oxford; Pergamon Press (1975).

From proceedings of course on the recycling and disposal of solid waste; Nottingham, England (1 Apr 1974).

A summary is presented of the kinds of radioactive wastes arising in the United Kingdom, mainly from the operation of the nuclear power industry; the relevant statutory and other controls; and the methods of radioactive waste disposal that are used. The related problem of handling and disposing of toxic chemical wastes is also discussed. (UK)

Handling Equipment and Procedures

Refer also to abstracts 29443, 29669, 30436, 30502–30505, and 32504.

30387 FERNBEDIENUNGSGERAETE ZUM ARBEITEN HINTER SCHUTZWAENDEN. Parallelmanipulatoren mit drei Gelenken. Anforderungen. Entwurf. (Remote Handling Devices for Use Behind Shielding Walls. Master-Slave Manipulators with Three Hinges. Specifications. Draft). DIN Deutsches Inst. fuer Normung e.V., Dortmund (F. R. Germany). Fachnormenausschuss Kerntecknik. (Jul 1975). 4p. (In German). (DIN-25409(Pt.5)).

4 tabs.

This draft standard specifies minimum requirements for master-slave manipulators with 3 hinges as well as criteria to be observed in their use and also gives recommendations for acceptance tests of this equipment. (DE)

30388 NUKLEARMEDIZINISCHE BETRIEBE. Regeln fuer die Errichtung und Ausstattung. Entwurf. (Installations for Nuclear Medicine. Regulations for Construction and Equipment. Draft). Berlin, F. R. Germany; Beuth (Sep 1975). 12p. (In German). (DIN-6844).

The standard contains rules for the construction and equipment of medical installations in which open radioactive materials are used in diagnostics, therapy and research. (DE)

30389 THE DEGREE OF DECONTAMINATION OF FLOORINGS AND COATINGS ACCORDING TO THE KARLSRUHE TESTING METHOD. Kunze, S. Boden Wand Decke; 20: No. 12, 32-38 (1974). (In German).

The method developed in the Nuclear Research Center, Karlsruhe, in the department of decontamination operations is presented, which besides the testing of the degree of decontamination of surface also includes physical and chemical investigations. The decontamination results of 78 tested floorings and 32 floor coatings are compiled in tables. A certain part of the materials investigated was used and observed in the facilities and institutes of the Nuclear Research Center. The results of the test methods correspond to the experience gained in practice. The influence of the resistance to chemicals of surface coatings is discussed.

30390 PROCEEDINGS OF THE 22ND CONFERENCE ON REMOTE SYSTEMS TECHNOLOGY, WASHINGTON, DC, Oct 1974. Farmakes, R.; Wojciechowski, D. Conf. Remote Syst. Technol., Proc.; 22: 1-106(Oct 1974).

Included are 14 papers and panel discussions on remote handling equipment and facilities in the nuclear industry. Eight papers were processed for inclusion in Nuclear Science Abstracts and/or ERDA Research Abstracts. Six papers were previously processed. (HDR)

For abstracts of individual papers see: 28826, 29066, 29443, 29669, 29670, 30391, 30392, and 32504.

30391 REMOTE APPLICATIONS IN FUEL FABRICATION: PANEL DISCUSSION. Conf. Remote Syst. Technol., Proc.; 22: 69-70(1974).

From 22nd conference on remote systems technology; Washington, DC, USA (Oct 1974).

30392 REMOTE APPLICATIONS IN WASTE PROCESSING: PANEL DISCUSSION. Conf. Remote Syst. Technol., Proc.; 22: 91-93(1974).

From 22nd conference on remote systems technology; Washington, DC, USA (Oct 1974).

30393 AUTOMATIC DOOR OPERATING MECHANISM FOR RADIATION PROOF ENCLOSURES. Hansen, C. A. (to Ray Proof Corp., Norwalk, Conn. (USA)). Canadian Patent 964,293. 11 Mar 1975. 14p.

Available from Commissioner of Patents, Ottawa.

A description is given of a radiation proof enclosure having: a door, a frame surrounding the door, frictionally engageable radiation barrier parts on the edges of the door and frame, and a means for moving the door with respect to the frame to engage or disengage the parts and to lock or unlock the door. A power operated mechanism opens and closes the door. Because of the construction of the radiation barrier, joints between the door and its frame require considerable pressure for the final closing and the initial opening operations. The mechanism consists of an electric motor having a rotatable shaft, a control circuit for the motor, an electrically operated friction brake mechanism for stopping the motor when the motor current is cut off by the control circuit, and means for manually rotating the motor shaft.

30394 GAS-HANDLING SYSTEM FOR STUDIES OF TRITIUM-CONTAINING MATERIALS. Carstens, D. H. W. (Los Alamos Scientific Lab., NM). Conf. Remote Syst. Technol., Proc.; 23: 69-70(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A gas-handling system for preparation and study of tritium-containing compounds and materials is described. The system at any one time can handle amounts of DT gas up to about 3 mole and has provisions for purification, storage, and measurement of the gas. Experimental conditions covering the ranges 20 to 800°C and 1.3 Pa to 137 MPa (10^{-2} torr to 20,000 psi) can be maintained.

30395 TRITIUM HANDLING FACILITIES AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Anderson, J. L.; Damiano, F. A.; Nasise, J. E. (Los Alamos Scientific Lab., NM). Conf. Remote Syst. Technol., Proc.; 23: 77-88(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A new tritium facility, recently activated at the Los Alamos Scientific Laboratory, is described. The facility contains a large dry box, associated gas processing system, a facility for handling tritium gas at pressures to approximately 100 MPa, and an effluent treatment system which removes tritium from all effluents prior to their release to the atmosphere. The system and its various components is discussed in detail with special emphasis given to those aspects that significantly reduce personnel exposures and atmospheric releases.

30396 STARTUP CONFIGURATION OF THE HOT FUEL EXAMINATION FACILITY/NORTH (HFEF/N). Swanson, N. J.; White, J. R.; Bacca, J. P. (Argonne National Laboratory, Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 109-126 (1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The Hot Fuel Examination Facility/North (HFEF/N) is a new hot cell complex provided primarily for postirradiation handling and examination of irradiation experiments on candidate fuels and materials in the liquid-metal fast breeder reactor (LMFBR) program and of experiments related to LMFBR safety. The facility is operated by Argonne National Laboratory at the Argonne-West site of the Idaho National Engineering Laboratory near Idaho Falls, Idaho. The facility was dedicated in July 1972, following which significant changes and additions were made to the facility and its equipment before initiation of hot operations March 31, 1975. The configuration of the facility at startup is described.

30397 TECHNIQUES FOR REMOTE MAINTENANCE OF IN-CELL MATERIAL-HANDLING SYSTEM IN THE HFEF/N MAIN CELL. Tobias, D. A.; Frickey, C. A. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 127-137(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

Operations in the main cell of HFEF/N have required development of remote handling equipment and unique techniques for maintaining the in-cell material-handling system. Specially designed equipment is used to remove a disabled crane or electromechanical manipulator bridge from its support rails and place it on floor stands for repair or maintenance. Support areas for the main cell, such as the spray chamber and hot repair area, provide essential decontamination, repair, and staging areas for the in-cell material-handling-system equipment and tools. A combined engineering and technical effort in upgrading existing master-slave manipulators has definitely reduced the requirements for their maintenance. The cell is primarily for postirradiation examination of LMFBR materials and fuel elements.

30398 UNIQUE METHOD FOR TRANSFERRING HIGHLY IRRADIATED COMPONENTS FROM AN ALPHA-GAMMA FACILITY. Taylor, D. S.; Iverson, G. M.; White, J. R. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 138-143(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

An alpha-containing transfer system was developed and placed in operation in the HFEF/N cask tunnel. Conventional sleeving techniques were adapted to provide a gastight and particulate-tight connection between the hot cell transfer penetrations and sealed containers positioned within nongastight shielding casks. The transfer technique is applied to all top-loading cask operations at HFEF/N.

30399 HANDLING SYSTEM FOR LARGE SODIUM LOOPS AT HOT FUEL EXAMINATION FACILITY. Hagmann, D. B. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 144-160(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A system for handling large sodium loops has been developed for HFEF/N. The system will be used for post-test operations on the Sodium Loop Safety Facility (SLSF) loop. This loop is 27 ft long, 5 to 19 in. in diameter, and weighs approximately 5 tons. The post-test operations include loop handling, test-train disassembly, loop disassembly, sodium handling, component examination, and waste disposal. System expansion is already under way with the development of equipment to remotely assemble test trains with preirradiated fuels.

30400 PNEUMATIC TRANSFER SYSTEM FOR INERT-ATMOSPHERE HOT CELLS. McClurkin, J. L.; Tobias, D. A. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 161-165(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A means has been provided at HFEF/N for rapid pneumatic transfers of small quantities of fuels and materials between cells containing inert gases. Carriers of 2- and 4-in. dia. are placed in pneumatic tubes, which are evacuated; gas is then introduced upstream of the carrier and a transfer of 50 to 150 ft is completed in 3 to 10 s. The systems are gastight and each terminal is isolated by a motorized ball valve. Radiation surface smears, metallographic specimens, and waste materials are transported with the systems.

30401 STORAGE OF IRRADIATED EBR-II SUBASSEMBLIES IN AN INERT ATMOSPHERE. Swanson, N. J.; Hirsch, P. R. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 166-172(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

For efficiency in scheduling examinations, heat-generating highly irradiated reactor fuel subassemblies are stored within the main cell of HFEF/N. The subassemblies require forced cooling at all times. Since the main cell contains an inert atmosphere and is hermetically sealed from the outside environment, some unique engineering problems had to be solved to ensure subassembly cooling at all times. Several levels of redundancy were provided in the coolant circuits and electrical power supply for these subassembly storage pits.

30402 HFEF/N IN-CELL MOTORIZED TRANSFER CART. Swanson, N. J.; Kifer, R. A. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 173-178 (1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A remotely operated, 200-lb-capacity motorized cart has been provided within the main cell of HFEF/N. This unique cart is used for transport of small items from cell entrance locks to and between work stations. The cart rails and busbars are mounted on the cell walls below the shielding window. The cart is loaded and unloaded using slave manipulators. It relieves the overhead handling systems from lightweight transfers and thus enhances plant operating efficiency.

30403 REMOTE EXAMINATION, DISASSEMBLY, AND REASSEMBLY OF GRID-TYPE REACTOR SUBASSEMBLIES AT HFEF. McKenzie, D. A.; Taylor, D. S. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 181-189(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The use of grid-type subassemblies in EBR-II requires new techniques and equipment for remote interim examination in HFEF. When standard subassemblies are dismantled, the hex tubes are removed and the elements or capsules are slid off the grid bars. When grid-type subassemblies are dismantled, the outer hex tubes are removed; the lower ends of the fuel elements are then released and these elements are gripped and pulled one at a time out of the grid-channel assembly. Several fuel elements can be removed for examination without disturbing the remaining elements.

30404 REMOTE ASSEMBLY, EXAMINATION, AND DISASSEMBLY OF TREAT EXPERIMENTS AT HFEF. Cook, J. H.; Teraguchi, K. T.; Walker, K. L.; Kerr, J. F. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 197-200(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The Hot Fuel Examination Facility (HFEF) of Argonne National Laboratory (ANL) is providing experiment-handling capabilities for Transient Reactor Test (TREAT) Facility experiments sponsored by both the Reactor Analysis and Safety Division of ANL and the Hanford Engineering and Development Laboratory. The pre-test handling capabilities include assembling the previously irradiated fuel elements into the test train and loading the test train into the loop. Post-test handling capabilities include preparation of the experiment for neutron radiography and experiment disassembly and shipping.

30405 HANDLING OF IRRADIATED ELEMENTS AND CAPSULES IN HFEF/N. White, J. R.; McClurkin, J. L.; Adam, M. F.; Hill, B. F. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 201-210(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

Specialized equipment for remote handling and examination of reactor fuel elements has been installed in the Hot Fuel Examination Facility/North (HFEF/N) at the Idaho Nuclear Engineering Laboratory. Standardized end fittings are attached to elements

having diameters of 0.174 to 0.850 in. and lengths to 94 in. The end fittings make the elements look alike to semiautomated handling equipment. Master-slave manipulation is largely eliminated by element handling. The equipment permits the computerized unattended examination of a magazine load of 20 elements.

30406 VISUAL EXAMINATION MACHINE FOR HFEF/N. McClellan, G. C.; Iverson, G. M. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 211-218(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The visual examination machine (VEM) for the Hot Fuel Examination Facility/North (HFEF/N) provides a sophisticated method for visually and photographically inspecting irradiated LMFBR fuel elements and capsules. The components of the VEM are an element-positioning stage, an advanced-design hot cell periscope, and a lighting system. These components eliminate the difficult master-slave manipulations formerly required at the HFEF for this examination and have the capability to completely control element positioning in a precise manner for improved, high-magnification viewing and photography. Incorporated into the design of the equipment were provisions for converting the VEM to a computer-controlled system that uses a videotape data record.

30407 DATA ACQUISITION AND PROCESS CONTROL SYSTEM FOR HFEF. Just, F. H.; Ramsthaler, J. A.; Hayner, G. O.; Bono, R. W. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 219-229(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The Data Acquisition and Process Control System (DAPCS) is a system for digital data acquisition and automatic control at selected examination stations of the HFEF Complex. The system is intended to be applied wherever the quantity and repetitive nature of examinations makes manual operation unattractive; a primary application is on precision gamma scanners. When controlling the gamma scanners and other devices that use element-positioning stages, the DAPCS supervises the scanning of irradiated elements and the taking of data as a function of position on the elements. The DAPCS is capable of a wide range of examination, monitoring, and data-compilation tasks.

30408 SERVOARM: A WATER HYDRAULIC MASTER-SLAVE MANIPULATOR. Wilson, K. B. (Remotion Co., Coeur d'Alene, ID). Conf. Remote Syst. Technol., Proc.; 23: 233-241(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A water-hydraulic-powered servomanipulator that minimizes inertia, weighs only 17 lb/arm, has a 22-lb capacity, provides a compact package, and is available at a relatively low cost has been developed. Because of the water hydraulic system and miniature sizes required, all components have been specially designed and developed. Programming is easily added, because a microcomputer and A/D conversion hardware are used for counterbalancing.

30409 DEMOLITION AND REMOVAL OF PLUTONIUM-CONTAMINATED FACILITIES AT HANFORD. Raile, M. N. (Atlantic Richfield Hanford Co., Richland, WA). Conf. Remote Syst. Technol., Proc.; 23: 252-262(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The successful demolition and cleanup of a plutonium-contaminated facility at the U. S. Energy Research and Development Administration Hanford Plant in Washington State are described. Several new materials, along with special techniques and equipment, were utilized for the containment and control of plutonium contamination during the course of the demolition work. The use of light-capacity fiber-glassed plywood boxes for long-term (20 yr, min) storage of the contaminated materials in underground transuranic waste trenches has led to the development, design, and use of larger capacity, modular, fiber-glassed plywood boxes that are replacing standard carbon steel boxes at less than one-third the cost, and without the potential for early failure from normal soil or atmospheric corrosion.

30410 DISMANTLING A PLUTONIUM FABRICATION FACILITY. Koprowski, B. J. (Argonne National Lab., IL); Kelman, L. R.; Schmitt, D. R.; Parker, S.; Januska, A. G. Conf. Remote Syst. Technol., Proc.; 23: 263-269(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The Plutonium Fabrication Facility (PFF) is being dismantled as part of a plan for consolidating and upgrading plutonium facilities at Argonne National Laboratory (ANL). The facility consists of fabrication equipment enclosed within a glove-box system interconnected by a conveyor. The glove-box system is being dismantled in sections and the sections are either being reinstalled or converted to scrap.

30411 MONITORING FOR LIGHT-TRANSMISSION CHANGES IN HFEF/N SHIELDING WINDOWS. Swanson, N. J.; Eckels, T. W. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 441-444(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The technical description of some of the Hot Fuel Examination Facility/North (HFEF/N) windows was presented at a previous conference. Recently, additional windows were obtained and installed. Although the two window types have nearly identical geometries, their contents are appreciably different. Both types of windows underwent a series of severe qualification tests before they were accepted for installation. These tests were considered necessary to minimize the possibilities of failure due to high-intensity gamma irradiation. The testing included irradiation of glass samples to high doses for measurement of browning and electrical discharge. Compatibility testing of the various components of a window tank was also performed in a high-radiation environment. This Technical Note describes the configuration of each of the windows and discusses the plan to be used for periodically monitoring for light-transmission changes induced by long-term exposures to high-level doses of gamma radiation.

30412 MINIATURE RADIATION-RESISTANT TELEVISION CAMERA. Monnet, P.; Robert, J. (CERN, Geneva). Conf. Remote Syst. Technol., Proc.; 23: 445-447(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The camera was designed to meet the special requirements that occur in operation of an accelerator. The camera is small, lightweight, insensitive to magnetic fields of about 100 G, highly reliable, and easy to maintain. (TFD)

30413 LIVERMORE PLUTONIUM ARRAY PROGRAM: EXPERIMENTS AND CALCULATIONS. Kolar, O. C.; Finn, H. F.; Pruvost, N. L. (Univ. of California, Livermore). Nucl. Technol.; 29: No. 1, 57-72(Apr 1976).

The first precision array measurements with high-density plutonium-metal cylindrical parts of 3 and 6 kg took place at the Livermore Critical Assembly Facility from 1965 to 1969. Cubic arrays of up to sixty-four 6-kg parts were measured. Mock high-explosive epoxy moderators were used in several measurements. Experiments observing the effects of simulated body reflectors provided personnel safety guidance for the construction of these arrays. A comparison of Monte Carlo calculations and the experimental measurements indicated that the calculational method is sufficiently accurate to be used in nuclear safety guidance for arrays of these elements. Included for comparison are calculations for arrays comprised solely of the plutonium parts. Also included are calculations for 6-kt-part arrays in which a 0.479-cm-wide gap at the midplane has been eliminated and where the spacing was varied for each idealized array.

Transportation

Refer also to abstracts 29786 and 32325.

30414 (INIS-mf) INSURANCE OF LIABILITY FOR THE TRANSPORT OF NUCLEAR MATERIALS. Deprimoz, J. (Pool Francais d'Assurances des Risques Atomiques, 75-Paris). 1975. 7p. (In French). INIS.

From colloquium on nuclear law and law of the sea; Paris, France (12 Jun 1975).

Colloquium organized by the Centre d'Etudes et de Recherches de Droit International and the Centre d'Etudes du Droit de l'Energie Atomique.

The legal principle governing civil liability for damage involving nuclear substances in course of carriage are summarized, and the main aspects of the French nuclear insurance market are analyzed. The financial capacity of insurance and the role of the Atomic Pool as an aid in this respect as well as its use as a mechanism for reinsurance are also discussed. As regards the insured party, cases are reviewed where the principle of the sole liability of the operator is inapplicable. Arguments are put forward demonstrating that acknowledgement of a plurality of insured persons would not necessarily lead to an increase of insurance costs. Finally, a review is made of the nature and extent of the damage covered according to whether such damage is caused to persons or property.

30415 (INIS-mf) TRANSPORT OF NUCLEAR MATERIAL UNDER THE 1971 BRUSSELS CONVENTION. Lagorce, M. (CEA, 75-Paris (France)). 1975. 17p. (In French). INIS.

From colloquium on nuclear law and law of the sea; Paris, France (12 Jun 1975).

Colloquium organized by the Centre d'Etudes et de Recherches de Droit International and the Centre d'Etudes du Droit de l'Energie Atomique.

The legal regime in force before entry into force of the 1971 Brussels Convention relating to civil liability for the maritime carriage of nuclear material created serious difficulties for maritime carriers, regarding both the financial risks entailed and restrictions on enjoyment of the rights granted by civil liability conventions. The 1971 Convention exonerates from liability any person likely to be held liable for nuclear damage under maritime law, provided another person is liable under the nuclear conventions or an equivalent national law. A problem remaining is that of compensation of nuclear damage to the means of transport for countries not having opted for re-inclusion of such damage in the nuclear law regime; this does not apply however to countries having ratified the Convention to date. A feature of the latter is that it establishes as extensively as possible the priority of nuclear law over maritime law. Furthermore the new regime continues to preserve efficiently the interests of victims of nuclear incidents. It is therefore to be hoped that insurers will no longer hesitate to cover international maritime carriage of nuclear material.

30416 PACKAGE FOR TRANSPORTING OR ENCLOSING RADIOACTIVE MATERIALS. Bochard, C. (to Robatel S. L. P. I.). US Patent 3,930,166. 30 Dec 1975. Filed Date 14 Dec 1973. 6p.

A package for transporting or enclosing radioactive materials emitting a large amount of heat, having a heat protection device provided between a container metal casing and an external jacket is described. The device comprises concentric rows of radial metal vanes between which an endothermic insulating material is placed, so that heat emitted by the radioactive material is discharged under optimum conditions, while the endothermic material forms an effective heat barrier against external heat.

30417 METHOD AND ARRANGEMENT FOR THE TRANSPORT OF HIGH RADIOACTIVE CYLINDRICAL WASTE BODIES. Weber, M.; Flinzberger, V. German (GDR) Patent 112,320/D/. 5 Apr 1975. 9p. (In German)

The device concerns a method and an arrangement which allows the economical transport of high radioactive cylindrical waste bodies in containers. The containers have nearly the same outer dimensions as the usual lead containers, but by means of an extension of the cooling area and no use of lead as a screen jacket material they have a better ratio of payload to nonpayload.

30418 MONTE CARLO SURFACE DENSITY SOLUTION TO THE DIRICHLET HEAT TRANSFER PROBLEM. Hoffman, T. J. (Univ. of Tennessee, Knoxville); Banks, N. E. Nucl. Sci. Eng.; 59: No. 3, 205-214(Mar 1976).

A new and efficient Monte Carlo approach to the solution of the Dirichlet heat transfer problem is developed and implemented. The adaptability of this approach to Monte Carlo radiation transport codes is highly useful for problems that require both heat transfer and radiation transport calculations, e.g., analyses of nuclear reactor fuel shipping casks. Criticality, shielding, and heat transfer calculations can be performed with one geometric description and one computer code.

30419 PROBLEMS OF TRANSPORTATION CONTAINERS FOR SPENT FUELS OF LIGHT-WATER REACTORS. Vesely, V.; Valvoda, Z. (Inst. of Nuclear Fuels, Zbraslav, Czech.). Jad. Energ.; 20: No. 1, 3-6(Jan 1974). (In Czech).

The transportation of power reactor spent fuels is primarily affected by the design and the materials of transportation containers. Physical properties are dealt with of shielding materials and the problems are discussed of heat transfer from the container surface. The dimensions and weight are also listed of containers for the VVER-440 fuels cooled in different ways. The possibility of applying metallic depleted uranium as the structural material for transportation containers is discussed. (NSAC)

PARTICLE ACCELERATORS

Refer also to abstract 31230.

Design, Development, and Operation

Refer also to abstracts 29040, 29052, and 31056.

30420 (AD/A-009325) FINAL LETTER REPORT ON PHASE 1 OF CONTRACT N00014-75-C-0003. Cecil, J. (Accelerators, Inc., Austin, Tex. (USA)). 17 Apr 1975. Contract N00014-75-C-0003. 28p. NTIS $3.75.

A summary is given of work done toward achieving goals for an ion implantation system. Special emphasis was placed on certain requirements which are: (1) system must be small and lightweight; (2) must implant ultrapure $^{27}Al^{+}$ with complete freedom from $^{23}Na^{+}$ contamination; (3) must be able to operate for long periods unattended; and (4) must achieve relatively high scanned beam currents at low energies. (GRA)

30421 (ANL-HEP-CP-76-05) SUPERCONDUCTING CYCLOTRONS. Blosser, H. G.; Johnson, D. A.; Burleigh, R. J. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). 1976. 15p. (CONF-750824-14). Dep. NTIS $3.50.

From 7th international conference on cyclotrons and their applications; Zurich, Switzerland (19 Aug 1975).

Superconducting cyclotrons are particularly appropriate for acceleration of heavy ions. A review is given of design features of a superconducting cyclotron with energy 440 (Q^2/A) MeV. A strong magnetic field (4.6 tesla average) leads to small physical size (extraction radius 65 cm) and low construction costs. Operating costs are also low. The design is based on established technology (from present cyclotrons and from large bubble chambers). Two laboratories (in Chalk River, Canada and in East Lansing, Michigan) are proceeding with construction of full-scale prototype components for such cyclotrons.

30422 (LA-6195-PR) MEDIUM-ENERGY PHYSICS PROGRAM. Progress Report, August 1–October 31, 1975. Dunn, E. (Comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 78p. Dep. NTIS $6.00.

Operations and research programs at the LAMPF Linac are reported for August, September, and October, 1975. The contents include: (1) a summary and a list of recent publications; (2) the engineering support; (3) the accelerator support; (4) accelerator systems development; (5) the injector systems; (6) electronic instrumentation and computer systems; (7) accelerator operations; (8) the experimental areas; (9) large-spectrometer systems; (10) research; (11) nuclear chemistry; (12) practical applications of LAMPF; and (13) management. (PMA)

30423 (LBL-4231) ELECTRON ACCELERATOR FOR TUNNELING THROUGH HARD ROCK. Avery, R. T.; Keefe, D. (California Univ., Berkeley (USA). Lawrence Berkeley L...). Oct 1975. Contract W-7405-Eng-48. 21p. (CONF-75[illegible]8-21). Dep. NTIS $3.50.

From first international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

Earlier work demonstrated that intense sub-microsecond bursts of energetic electrons cause significant pulverization and spalling of a variety of rock types. The spall debris generally consists of sand, dust, and small flakes. If carried out at rapid repetition rate, this can lead to a promising technique for increasing the speed and reducing the cost of underground excavation of tunnels, mines, and storage spaces. The conceptual design features of a Pulsed Electron Tunnel Excavator capable of tunneling approximately ten times faster than conventional drill/blast methods are presented, with primary emphasis on the electron accelerator and only a brief description of the tunneling aspects. Of several candidate types of accelerators, a linear induction accelerator producing electron pulses (5 MV, 5 kA, 1.0 mu s equals 25 kJ) at a 360 Hz rate was selected for the conceptual example. This provides the required average electron beam power output of 9 MW. The feasibility of such an accelerator is discussed.

30424 BASIC DOSIMETRIC MEASUREMENTS AT THE BRNO SIEMENS 42 MeV BETATRON. Caha, A.; Kotas, J.; Spurny, V.; Krystof, V.; Ott, O.; Koukola, V.; Tauer, Z.; Pecina, J. (Onkologicky Ustav, Brno (Czechoslovakia). Betatronove Pracoviste). Cesk. Radiol.; 29: No. 1, 66-71(Jan 1975). (In Czech)

Problems encountered in putting a new betatron ward into clinical operation are discussed. A number of dosimetric methods were tested, including ionization chamber dosimetry, scintillation dosimetry, the use of a Geiger-Mueller counter, film and chemical dosimetry, activation methods, neutron dosimetry, and calorimetric dosimetry. Spectrophotometry on the 224 nm and 305 nm wavebands was found to be the optimum evaluation method when measuring with a Fricke chemical dosemeter. Also, a TLD system using equipment VA-M-30 was applied.

30425 VERY HIGH ENERGY HEAVY-ION ACCELERATORS. Grunder, H. A. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 892-896(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A brief review is given of the status of heavy-ion accelerators and their ion source needs. The present performance of the superHILAC and the Bevalac is discussed, and applications of heavy-ion accelerators outside of basic research are presented. (PMA)

30426 LARGE TANDEM ACCELERATORS. Jones, C. M. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 913-917(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The increasing importance of energetic heavy ion beams in the study of atomic physics, nuclear physics, and materials science has partially or wholly motivated the construction of a new generation of tandem accelerators designed to operate at maximum terminal potentials in the range 14 to 30 MV. In addition, a number of older tandem accelerators are now being significantly upgraded to improve their heavy ion performance. Both of these developments have reemphasized the importance of negative heavy ion sources. The new large tandem accelerators are described, and the requirements placed on negative heavy ion source technology by these and other tandem accelerators used for the acceleration of heavy ions are discussed. First, a brief description is given of the large tandem accelerators which have been completed recently, are under construction, or are funded for construction, second, the motivation for construction of these accelerators is discussed, and last, criteria for negative ion sources for use with these accelerators are presented.

30427 COLLECTIVE METHODS OF PARTICLE ACCELERATION. Tsytovich, V. Veda Tech. SSSR; 2: No. 6, 50-53(Dec 1974). (In Czech).

Various methods of collective plasma acceleration are discussed.

30428 NEUTRON GENERATOR WITH DEMOUNTABLE HIGH TENSION CONNECTOR. (to Philips Gloeilampenfabrieken, V.V.). Netherlands Patent 7,312,546/A/. 12 Sep 1973. 7p. (In Dutch).

A neutron generator is described consisting of a Penning-type ion source from which tritium and deuterium ions are accelerated and absorbed in a target. The accelerated ions will generate 14 MeV neutrons by (d,t) reactions with absorbed ions. The invention focuses on the insulation of the demountable high tension part of the Penning-type ion source where oil is used as an insulator. Ionizing radiation has the effect of decreasing the insulating properties of the oil. Moreover, impurities might form bridges causing breakdown. Both effects can be largely diminished by pumping the oil in a circuit, using it as a cooling medium at the same time.

30429 FOIL SCATTERING IN A REFLEX TRIODE INTENSE ION BEAM ACCELERATOR. Antonsen, T.M. Jr.; Ott, E. (Department of Electrical Engineering, Cornell University, Ithaca, New York 14853). Appl. Phys. Lett. 28: No. 8, 424-426 (15 Apr 1976).

The electron and ion current densities flowing in a reflex triode are calculated. Our analysis self-consistently determines the electron distribution function resulting from electron collisions with a foil anode and the potential in the triode. The electron and ion currents diverge for a sufficiently thin anode. (auth)

Auxiliaries and Components

Refer also to abstracts 29236, 29391, 30412, and 31416.

30430 (ORNL-tr-4087) MAGNETIC MEASUREMENTS MADE AT OAK RIDGE ON THE CSS MAGNET MODEL, 0.15 SCALE. Barre, M.; Bourgarel, M. P.; Luong, T. T.; Ohayon, M. 1975. Translation by M. Gerrard of GANIL-75-42. 35p. Dep. NTIS $4.00.

Measurements were made of magnetic fields of a four-sector model magnet (with characteristics similar to those of the GANIL magnet) for use in calculating particle dynamics. Objectives included studying the effect of profile shims, simulating the injection

septum, obtaining a field map in the presence of injection magnets, and acquiring experience in making magnet measurements. The results were precise enough for dynamic calculations and for use by magnet specialists. (PMA)

30431 (UCRL-Trans-10763) STUDIES OF MULTIPERIODIC STRUCTURES BY MEANS OF CIRCUITS WITH DISCRETE ELEMENTS. Tran, D. T. Translated by M. Martin from Nucl. Instrum. Methods; 98: No. 2, 285-299(1972). 28p. Dep. NTIS $4.00.

In modern linear accelerators, magnetrons, and travelling wave tubes, to reduce the beam loading effect and to reconcile the structure efficiency and its sensitiveness to mechanical errors, sophisticated structures are often designed by associating several elementary circuits. Because several pass-bands can interfere, the dispersion properties of such multiband structures were studied. Using matrix calculus and applying the positive real properties of impedance, the behavior of series-coupled and parallel-coupled structures is derived. Forms of dispersion curves of biperiodic, triperiodic structure, deflecting structure, interdigital structure, and others are discussed. Experimental work is presented on a few modern structures to illustrate the theoretical work. A new structure, derived from the organ pipe structure and proposed recently as a variable energy accelerating structure, is discussed, and interdigital structures are considered.

30432 PROCESS COMPUTERS AUTOMATE CERN POWER SUPPLY INSTALLATIONS. Ullrich, H.; Martin, A. (Eur Nucl Res Cent (CERN), Geneva, Switz). Siemens Rev.; 41: No. 8, 347-351(Aug 1974).

Computerized automation systems are being used at CERN, Geneva, to improve the capacity, operational reliability and flexibility of the power supply installations for main ring magnets in the experimental zones of particle accelerators. A detailed account is given of the technological problem involved, and descriptions of the system configuration, the program system, and field experience already gathered in similar schemes are given.

30433 PROCESS COMPUTERS AUTOMATE CERN POWER SUPPLY INSTALLATIONS. Ullrich, H. (European Organization for Nuclear Research, Geneva (Switzerland)); Martin, A. (Siemens A. G., Erlangen (F.R. Germany). Geschaeftsbereich Verkehr, Transport, Forschungsstaetten). Siemens Rev.; 41: No. 8, 347-351(Aug 1974).

Higher standards of performance and reliability in the power plants of large particle accelerators necessitate increasing use of automation. The CERN (European Nuclear Research Center) in Geneva started to employ process computers for plant automation at an early stage in its history. The great complexity and extent of the plants for high energy physics first led to the setting-up of decentralized automatic systems which are now being increasingly combined into one interconnected automation system. One of these automatic systems controls and monitors the extensive power supply installations for the main ring magnets in the experimental zones. (DE)

30434 INSTALLATION FOR MEASURING THE PROFILE OF A PARTICLE BEAM. Antipov, Yu. M.; Bushnin, Yu. B.; Dunaitsev, A. F.; Rybakov, V. G.; Sen'ko, V. A.; Sytin, A. N.; Soldatov, M. M.; Kholkin, A. N. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1027-1028(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 24-25(1975).

In order to determine the geometric position and profile of the particle beam applied to the "Mirabel" chamber from the 70-GeV accelerator at the Institute of High-Energy Physics, a 64-channel installation which measures the beam profile was developed. The installation was designed for operation in the fast-extraction regime of the accelerator having a duration not exceeding 10^{-3} sec. The detection of the beam is accomplished by means of two proportional chambers turned at an angle of 90°.

30435 REGULATED CURRENT SOURCE (TO 3200 A) FOR SUPERCONDUCTING SOLENOID. Bychkov, N. S.; Lachinov, V. M.; Popov, A. A.; Khabarov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1187-1190(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 144-148(1975).

A regulated current source is described which delivers a maximum current of 3200 A and is designed to supply the superconducting solenoid of the accelerating section of a ring accelerator. The regulation system uses a circuit with negative current feedback, and the current is controlled by 600 transistors. The circuit uses integrated-circuit operational amplifiers and the rate of current increase (0.5 to 20 A/sec) is adjusted by a special digital-integrator circuit. Load-current stability is better than 10^{-3} for currents in excess of 1000 A.

30436 MASSIVE SHIELDING ADAPTED TO REMOTE MAINTENANCE METHODS. Franke, P. R, Jr. (Los Alamos Scientific Lab., NM). Conf. Remote Syst. Technol., Proc.; 23: 20-23 (1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

Massive shielding systems for the meson targets and the main beam stop at LAMPF were designed, fabricated, and installed to permit complete remote maintenance in the highly radioactive areas. The shielding is formed into large movable cover sections above the source areas and into plugs that can be handled with remote equipment near the hardware.

30437 BISON-NET: A CAMAC HIGH SPEED BLOCK DATA COMMUNICATION CHANNEL. Brenner, A. E.; Curtis, D. B.; Droege, T. F.; Dunne, R. A.; Martin, R. G. (Fermi National Accelerator Lab., Batavia, IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 442-447(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A high speed network communications station has been developed to serve to interconnect a variety of computers in a multiplexed star network. Each station consists of one control module and two memory modules embodied as CAMAC modules. Transmission is over coaxial lines with typical distances between stations of from 1 to 2 miles. (auth)

30438 CAMAC BASED COMPUTER–COMPUTER COMMUNICATIONS VIA MICROPROCESSOR DATA LINKS. Potter, J. M.; Machen, D. R.; Naivar, F. J.; Elkins, E. P.; Simmonds, D. D. (Los Alamos Scientific Lab., NM). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 448-451(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Communications between the central control computer and remote, satellite data acquisition/control stations at The Clinton P. Anderson Meson Physics Facility (LAMPF) is presently accomplished through the use of CAMAC based Data Link Modules. With the advent of the microprocessor, a new philosophy for digital data communications has evolved. Data Link modules containing microprocessor controllers provide link management and communication network protocol through algorithms executed in the Data Link microprocessor. (auth)

30439 AUXILIARY/MASTER MICROPROCESSOR CAMAC CRATE CONTROLLER APPLICATIONS. Barsotti, E. (Fermi National Accelerator Lab., Batavia, IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 452-455(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The need for further sophistication of an already complex serial CAMAC control system at Fermilab lead to the development of an Auxiliary/Master CAMAC Crate Controller. The controller contains a Motorola 6800 microprocessor, 2K bytes of RAM and 8K bytes of PROM memory. Bussed dataway lines are time shared with CAMAC signals to provide memory expansion and direct addressing of peripheral devices without the need of external cabling. The Auxiliary/Master Crate Controller (A/MCC) can function as either a Master, i.e., stand alone, crate controller or as an Auxiliary controller to Fermilab's Serial Crate Controller (SCC). Two modules, one single and one double-width, make up an A/MCC. The double-width module contains the necessary crate controller hardware, i.e., read/write registers, station number registers, dataway cycle timing generator, etc. in addition to hardware providing input and output block transfer capabilities through the SCC. When the A/MCC is used as an auxiliary controller, the single-width module contains the microprocessor, RAM, PROM, MPU clock, and the timing and logic circuitry required for interleaving A/MCC and SCC dataway cycles as well as extending memory via dataway lines. When the A/MCC is functioning as a master crate controller, the first single-width module or one with DMA cycle-stealing transfer capabilities may be used. The module, in this latter case, need not and thus does not have dataway cycle interleaving capabilities. (auth)

30440 SERIAL DRIVER MODULE FOR THE CAMAC SERIAL HIGHWAY SYSTEM. Machen, D. R.; Potter, J. M.; Thomas, R. F. Jr. (Los Alamos Scientific Lab., NM). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 456-458(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A Serial Driver has been developed at The Clinton P. Anderson Meson Physics Facility (LAMPF) for use in accelerator control and beam-line data-acquisition applications. The driver fully meets the requirements of the CAMAC Serial System Description (ERDA TID-26488 and ESONE/SH/01) while providing a number of features useful in system operation, diagnosis, and testing of SCC-L1 crate controllers.

Ion Sources and Injection and Extraction Systems

Refer also to abstracts 30425 and 30426.

30441 (CEA-CONF-3196) A MULTIPLY CHARGED ION SOURCE FOR ATOMIC AND ELECTRONIC COLLISION STUDIES. Apard, P.; Geller, R.; Jacquot, B.; Jacquot, C.; Bliman, S. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Grenoble, 38 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service d'Ionique Generale). 1975. 6p. INIS.

From 9th international conference on the physics of electronic and atomic collisions; Seattle, USA (24 Jul 1975).

An electron cyclotron resonance source was built which exhibited good gas efficiency and low gas pressure in the source and in the extraction region. The current density that can be extracted at 12 kV is on the order of 240 mA/cm^2. For nitrogen, charge states of up to +5 may be reached, with a charge +4 abundance of about 1%. Another remarkable property is the normalized emittance value of 4.5 10^{-7} m-rad at 10 kV.

30442 SLOW BEAM EXTRACTION FROM THE JINR SYNCHROPHASOTRON. Issinsky, I. B.; Kalyonov, S. V.; Kulakova, E. M.; Novikov, S. A.; Omel'chenko, B. D.; Pavlov, N. I.; Sikolenko, V. F.; Vasilishin, B. V.; Volkov, V. I.; Zinoviev, L. P. (Jt Inst for Nucl Res, Dubna, USSR). Part. Accel.; 5: No. 4, 215-226(1973).

A slow extraction system was designed which operates on the $\nu_x = 2/3$ radial betatron resonance and permits extraction of more than 90% of a circulating beam by means of two internal magnets. The main relations describing the beam behavior under resonance conditions and the preliminary parameters of the extraction system are calculated analytically. The dynamic beam characteristics and extraction system performance are computed, taking into account the measured synchrophasotron parameters.

30443 INVESTIGATION OF AN ELECTRON BEAM ION SOURCE FOR THE PRODUCTION OF MULTIPLY CHARGED HEAVY IONS. Clausnitzer, G.; Klinger, H.; Mueller, A.; Salzborn, E. (Univ., Giessen, Ger.). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1027-1030(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

An electron beam ion source for the production of multiply charged heavy ions was developed. Dc ion beams of neon, argon, krypton, and xenon ions were produced. Xenon beam currents are in the range from some 10^{-9}A for Xe^{10+} up to about 10^{-6}A for charge states lower than Xe^{4+}. The ion source proved to be very reliable and simple to operate. The analyzed charge spectra are compared with a theoretical model which allows for computation of the ion charge distribution in dependence on various source parameters.

30444 TIME-OF-FLIGHT EBIS WITH UNUSUAL CATHODE OPERATION. Kleinod, M.; Becker, R.; Klein, H.; Schmidt, W. (Univ., Frankfurt am Main). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1023-1026(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The principle of an electron beam ion source in time-of-flight mode was verified in an experimental arrangement with low electron currents but high current densities due to an unusual cathode process. By varying only the applied axial electric field, maxima in the relative abundance of the charge state distributions up to 4^+ for Ar and 5^+ for Xe could be obtained. Relative abundances as well as absolute ion yields and their dependence on the different parameters can be explained by a theoretical model using a Monte Carlo program. Based on these investigations, an extrapolation was made for ion yields which may be obtained in a TOFEBIS with high electron current and current densities.

30445 FRANKFURT EBIS WITH TIME-OF-FLIGHT OPERATION. Becker, R.; Klein, H. (Univ., Frankfurt am Main). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1017-1022(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

An EBIS with dc output was built which runs in a time-of-flight mode of operation, e.g., the ions become highly charged during the time of flight in the electron beam from one end of the source to the other. Design principles to produce current densities above 10^3 A/cm^2 were applied in constructing the source, including a high power electron gun and magnetic compression of the accelerated beam. First tests on the ionization of argon show that desorption requires attention at the electron collector. Cathode extraction of ions has proved to be quite satisfactory, promising great flexibility in producing ions from any element, gaseous or solid.

30446 CURRENT RESULTS FROM THE TEXAS A AND M ELECTRON BEAM ION SOURCE. Hamm, R. W.; Choate, L. M.; Kenefick, R. A. (Texas A and M Univ., College Station). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1013-1016(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The electron beam ion source (EBIS) at Texas A and M University was constructed and is currently undergoing tests on the injection and transmission of the electron beam through the solenoid. Results of computer simulation of the electron beam are presented, as well as measurements of electron beam profiles using a pinhole beam analyzer.

30447 ANODE SPUTTERING CHARACTERISTICS OF THE BERKELEY 2.5 MV SOURCE. Gavin, B. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1008-1012(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

An investigation of a number of parameters affecting the performance of the SuperHILAC 2.5 MV Adam injector source is reported. The description emphasizes anode sputtered materials, and calcium and gold ion production is discussed in some detail. Electrode geometry, support gas type, and electrode bias were varied to optimize beam intensity and electrode consumption. A factor of three improvement with high n^+ gold ions appears evident with a new displaced electrode geometry. The source is operated in cold mode, is pulsed, and operates usually at less than 0.6 amperes average current. Under these conditions, the source life was sixteen hours at 25 percent duty factor when generating calcium ions with neon support gas.

30448 HEAVY ION ACCELERATION AT CYCLONE (BELGIUM). Jongen, Y.; Ryckewaert, G. (Univ. of Louvain-la-Neuve, Belgium). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 987-990(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

CYCLONE is an isochronous cyclotron, equipped with a P. I. G. hot cathode heavy ion source, which accelerates various ions up to energies of 110 MeV Q^2/A with extracted beam intensities reaching 10 mu A in the 4^+ state. The source is described, and some performance parameters are given. In order to reach higher charge states, an injector cyclotron is projected which will allow a final energy of 27 MeV/nucleon up to neon, decreasing to 6 MeV/nucleon for xenon. Extracted intensities vary between 5 x 10^{13} and 10^9 pps depending on particle and energy. Some design aspects are described which will allow the cost of the project to be quite low.

30449 ORSAY ELECTRON BEAM ION SOURCE. Arianer, J.; Goldstein, C. (Inst. of Nuclear Physics, Orsay, France). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 979-986(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Basic parameters of the electron beam ion source (EBIS) are defined. The experimental results of the Orsay EBIS are described. The design of a synchrotron source for production of fully-stripped heavy ion beams and polarized protons is given.

30450 REVIEW OF THE JINR ELECTRON BEAM ION SOURCES. Donets, E. D. (Joint Inst. for Nuclear Research, Dubna, USSR). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 897-903 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A review of the electron beam sources of highly-stripped ions, developed at the Joint Institute for Nuclear Research during 1967-75, is given. The effective experimental ionization cross sections of positive C, N, Ar, and Xe ions by electron impact are presented. Possible fields of application of electron beam ion sources are indicated.

30451 MULTIPLY CHARGED ION SOURCE WITH INDIRECTLY HEATED CATHODE. Makov, B. N. (Inst. of Atomic Energy, Moscow). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1035-1041(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A survey on questions related to the production of multiply charged ions with the hot cathode ion source is given. Some characteristics of the ion source with heated cathode are discussed. It is shown that the use of hydrogen as a ballast gas in the discharge gives some possibilities for increasing the intensity of beam of multiply charged ions. The perpendicular plasma pressure of the discharge column is measured, and values of T/sub e/ and n are estimated. From the axial distribution of the ion charge states, it is concluded that a potential well trapping ions should exist in the discharge column. It is shown that local inhomogenities

of the magnetic field along the discharge column give rise to a substantial increase of the intensity of multiply charged ion beams.

30452 DEVELOPMENT OF PENNING MULTIPLY CHARGED ION SOURCES FOR THE UNILAC. Schulte, H.; Jacoby, W.; Wolf, B. H. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1042-1048 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Two types of PIG sources suitable for generation of multiply charged metal ions are currently under investigation. One is equipped with a sputtering electrode, with the central part of the anode being run very hot to achieve effective re-evaporation of the sputtered material. Furthermore, source feed by use of ovens was applied. The other source uses plasma-heated cathodes and sputtering electrodes of cylindrical shape surrounding the plasma column almost entirely. For both source types, Ar is preferred as support gas. The content of metal ions in the total extracted current ranges from approximately 10 percent to 80 percent, depending on source type and metal species. Among other ions, Ta^{10+}, Au^{9+}, Bi^{10+}, and U^{11+} were obtained.

30453 DUOPLASMATRON DEVELOPMENT. Keller, R.; Mueller, M. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1049-1052 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The duoplasmatron was studied with particular emphasis on the production of multiply charged heavy ions. Experiences and results achieved in the past lead to the construction of a source permitting the application of higher discharge power and ion extraction from the point of highest density in the plasma. With pulsed operation, discharge conditions were found where ions up to Xe^{11+} are extracted. Outlines of further development of a duoplasmatron type heavy ion source are sketched.

30454 ION AND ELECTRON FLOW IN HOT-CATHODE PIG SOURCES FOR MULTIPLY CHARGED HEAVY IONS. Schulte, H. (GSI Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.); Wolf, B. H.; Winter, H. IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1053-1060 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Calorimetric measurements of the power dissipated at both the anode and the anticathode of a hot-cathode Penning ion source were made. The analysis leads to the existence of a considerable electron flow from the PIG plasma onto the cathodes, which is in agreement with the electron currents extracted through holes in the cathodes of a hot-cathode PIG source. Neither the measured plasma electron temperature of less than 15 eV nor the emission of electrons from the cathodes with velocities greater than 0 provide an explanation. Therefore, it is assumed that a fraction of primary electrons is heated by means of nonlinear collective plasma processes. A PIG discharge model involving a peculiar velocity distribution of the ionizing electrons is presented.

30455 STUDIES OF A PIG SOURCE FOR POSITIVE ION EXTRACTION. Heinicke, E.; Nickel, W.; Rang, B.; Bethge, K. (Univ., Frankfurt am Main). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1061-1064 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The extraction of highly positive charged ions from a PIG source with axial geometry was investigated by studying the discharge conditions for high discharge currents (up to 1 A), very high magnetic fields (B approximately 18 KT), and with additional electron injection from a duoplasmatron. Compared to an earlier version of the source, the total extracted beam current was somewhat improved, but the charge state distribution remained essentially the same.

30456 PRODUCTION OF POSITIVE ION BEAMS FROM SOLIDS. Hudson, E. D.; Mallory, M. L.; Lord, R. S. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1065-1068 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Metal and non-metal ions from solids are produced in a Penning ion source by a process that involves ions that are unable to cross the first acceleration gap between the ion source and dee and are accelerated back into the ion source where they sputter charge material into the arc. This material is ionized and extracted from the ion source and accelerated. This technique was used for a large variety of ions, both metal and non-metal, including most recently aluminum from the metal and boron from boron nitride charge materials. The efficiency for making iron ions with different ion support gases was calculated and experimentally checked. A dual ion source is being designed for the dc Penning ion source test stand which should make an excellent source for producing ions from solids for dc extracted Penning ion sources.

30457 PENNING MULTIPLY CHARGED HEAVY ION SOURCE TEST FACILITY. Mallory, M. L.; Crandall, D. H. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1069-1072 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

An ion source test facility was constructed for making fundamental measurements of the properties of Penning ion sources. The extracted ion energies from the source can be up to 36 x q (keV), where q is the ion charge. Both negative and multiply charged positive ions have been extracted from the source. The facility has high current capabilities for acceleration and for the arc power supply. These low-energy, multiply charged ions are currently being used for measurements of charge exchange cross sections, x-ray production, and electron impact excitation and ionization.

30458 HEAVY ION SOURCE DEVELOPMENT AT THE BEVATRON. Richter, R. M.; Zajec, E. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1073-1076 (Apr 1976).

From international conference on heavy ion sources, Gatlinburg, TN, USA (27 Oct 1975).

The Bevatron 20 MeV duoplasmatron source is currently being modified with the goal of producing 1 mA of $^{20}Ne^{3+}$. Initial tests at 420 keV show a total beam of 20 mA of which 400 mu A is $^{20}Ne^{3+}$. The quantity of beam in various charge states is determined with a pulse field magnetic spectrometer. Titanium sublimation and cryogenic pumping of the PIG source in the high voltage terminal and its resultant effects on the acceleration of carbon and nitrogen are discussed.

30459 EMITTANCE MEASUREMENTS OF HIGH CHARGE STATE ARGON BEAMS FROM A PIG SOURCE. Bex, L.; Clark, D. J.; Ellsworth, C. E.; Estrella, R. M.; Gough, R. A.; Holley, W. R. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1077-1080 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The emittances of beams of Ar^{4+} to Ar^{8+} were measured in the axial and radial planes. The extraction voltage was 10 kV and the magnetic field was varied from about 0.5 to 0.6 Tesla. The anode slit was varied in its distance from the arc which was run both dc and pulsed. The emittance was found to be nearly independent of charge state but to increase with total beam current. A small bowing of the arc column was discovered, which made evaluation of mirror field effects difficult.

30460 EMITTANCE AND BRIGHTNESS OF ION BEAMS FROM A PIG ION SOURCE WITH END EXTRACTION. Baumann, H.; Bethge, K.; Klein, G. (Univ., Frankfurt am Main). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1081-1083 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The emittance of positive ion beams extracted from a PIG ion source with end extraction was measured for optimal operating conditions of the source at different positions of the beam line. The source was operated with noble gases in a high voltage–low current discharge mode. The results showed that the emittances increase with increasing ion mass and intensity of the ion beam and furthermore under the influence of the space charge of the beam with the distance from the source. For ion beam intensities of 1 mA, values of the emittance were obtained between 0.4 and 1.1 cm mrad MeV/sup $^1/_2$/ at a distance of 10 cm behind the extraction region. The brightness varied from 0.15 to 1.3 mA cm^{-2} $mrad^{-2}$ MeV.

30461 A CW DUOPIGATRON MULTIPLY-CHARGED ION SOURCE. Lejeune, C.; Grandchamp, J. P.; Gilles, J. P.; Aubert, J. (Paris Univ., Orsay, France). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1084-1087 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A systematic study of the duopigatron has shown that this type of source is very convenient for the production of intense dc ion beams (greater than 10mA) of heavy elements with moderate charge states, if the operation and design parameters are properly matched. The charge state density distribution compares with the best results reported for dc duoplasmatrons, whereas the discharge power is less or equal. For argon, with a 0.8 kW power, the percentage of particles in the beam is: A^+ equals 38, A^{2+} equals 50,4, A^{3+} equals 11, A^{4+} equals 0.5, A^{5+} approximately equals 0.1; the overall gas utilization factor being 80 percent if an insulating material (BN) is used for the anticathode and expansion cup construction. The total beam intensity is determined by the diameter

of the hole bored on the axis of the anticathode electrode, and the ion current density in this plane is comparable to that at the anode plane of a duoplasmatron (approximately equal to 2 A/cm^2). The normalized emittance of the beam is E/sub N/ equals 4 x 10^{-7} m x rd for a total beam intensity of 7.8 mA, which corresponds to an emissive hole of 0.8 mm diameter and a brightness of B/sub N/ approximately equal to 10^{10} A^{-2}/sub xm/ xrd^{-2}.

30462 EMITTANCE AND BRIGHTNESS OF MULTIPLY-CHARGED ION BEAMS FROM DUOPIGATRON AND DUOPLASMATRON SOURCES. Aubert, J.; Gautherin, G.; Gilles, J. P.; Grandchamp, J. P.; Lejeune, C. (Paris Univ., Orsay, France). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1088-1092 (Apr 1976).

The systematic study of the dependence of the charge state density distribution (CSDD) on the discharge parameters of both the duopigatron and the duoplasmatron sources was conducted. The experimental data show that for both sources the optimum conditions for multiply-charged ion production correspond to the operation of the discharge at points between two different modes. In particular, the pressure must be matched to a minimum value corresponding to the arc starvation mode. Under this condition the discharge exhibits large level fluctuations which are correlated with enlarged ion energy spreads. However, the instability level can (particularly in the duopigatron) be minimized by a proper choice of the magnetic field shape and magnetic field strength. In order to describe more completely the source performances, the emittance and brightness were measured under optimum conditions for production of multiply-charged ions in our design. Solutions were proposed to improve emittance and brightness by the adaptation of a plasma expansion cup. These solutions do not inversely affect the CSDD. The obtained performances are compared with other experiments.

30463 DUOPLASMATRON FORMATION OF He^{++} IONS. Marghitu, S. (Inst. of Atomic Physics, Bucharest). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1093-1096 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Experiments concerning the He^{++} formation with a duoplasmatron are presented. The measurements for choosing the suitable parameters of the source were made with a test setup located immediately after extraction electrode of the source. A method for estimation of the partial H_2^+ and He^{++} currents is proposed. The mass analysis was made alternately for hydrogen and helium in the source and for a mixture of both in the expansion cup. With equal partial pressures of helium and hydrogen inside the plasma cup, the analyzed He^+ peak does not change, the H^+ peak increases by 30 percent, and the ($He^{++} + H_2^+$) by 75 percent.

30464 DUOPLASMATRON TYPE SOURCE WITH COLD CATHODE. Batalin, V. A.; Kolomietz, A. A.; Kondratiev, B. K.; Kuibida, R. P. (Inst. of Theoretical and Experimental Physics, Moscow). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1097 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The duoplasmatron is widely used as a high-intensity ion source. The LINAC I-2, which is the injector of a 10 GeV PS, uses a duoplasmatron with a cold cathode. The initial cathode was a heated tantalum filament which was placed in a hollow tantalum cylinder with a wall thickness of 0.1–0.5 mm. It was subsequently discovered that it was not necessary to heat the filament in order to maintain the arc discharge and therefore the filament was used only for source bakeout. Now a thin-wall tantalum cylinder is used as the cathode. The cathode lasts up to 6000 h, requiring replacement approximately once a year.

30465 FURTHER INVESTIGATIONS OF (ANIS) THE AARHUS NEGATIVE ION SOURCE. Tykesson, P.; Anderson, H. H.; Heinemeier, J. (Univ. of Aarhus, Denmark). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1104-1108 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The recently described ANIS source of the cesium-doped, sputtering type was the subject of further investigation. The range of beams obtained was extended with beams of Li^- (1 mu A) and BO^- (2.5 mu A). The quality of the ion beam emitted from the source was investigated in terms of emittance, brightness, and energy distribution.

30466 DEVELOPMENT OF THE INVERTED SPUTTER SOURCE. Chapman, K. R. (Florida State Univ., Tallahassee). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1109-1112 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A sputter source is described in which the beam is extracted through the ionizer. This gives a very compact source with easily changed cones. The beam transmissions through an electrostatic accelerator are good, and life times in excess of a month between services are normal.

30467 PIG SOURCES UTILIZING SPUTTERING FOR NEGATIVE ION FORMATION. Smith, H. V. Jr. (Univ. of Wisconsin, Madison). IEE Trans. Nucl. Sci.; NS-23: No. 2, 1118-1121 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Recent measurements are described which give information about the formation of negative ion beams from the cathode material in SPIGS and emittance measurements for SPIGS and an ANIS source. In SPIGS, the mechanism of negative ion formation from the cathode material is direct Cs-assisted sputtering of negative ions into the discharge, followed by thermalization in the plasma before extraction. A correlation was found between the negative ion yield of SPIGS and the electron affinity (e,a,) of the negative ion (the larger the e.a., the larger the yield). Correlation of sputtered negative ion output with electron affinity is also observed for ANIS and a surface ionization source. In SPIGS, the low electron affinity negative ions are attenuated in the plasma more than the high electron affinity ions. Thus, SPIGS has lower output for the low e.a. ions than ANIS and the surface ionization source. Emittance measurements of the Cu^- beam from SPIGS and ANIS indicate that both sources have two-dimensional emittance approximately 5 mm mrad MeV/sup ½/ for 90 percent of the total beam. Thus ANIS has higher brightness than SPIGS for the low electron affinity negative ions.

30468 HIGH-INTENSITY SOURCE OF HEAVY NEGATIVE IONS. Fasolo, J. A. (Argonne National Lab., IL). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1122-1125 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

An early version of the developmental H^- ion source for the Argonne Zero Gradient Synchrotron (ZGS) produced about 4 mA of negative ions in the mass range of 15 to 18 amu under conditions such that discharge cleaning of the source could not occur. The source was constructed almost entirely of carbon-bearing, oxide-covered mild steel and stainless steel. The gas outflow was pulsed. At low arc and gas pulse rates, wall-plasma interactions produce volatile compounds such as CO, CH_4, C_2H_8, H_2O, etc. Ionization of these compounds and the fragments formed by their dissociation results in high levels of contaminants in the plasma and the positive ion beam emerging from the source; correspondingly high levels of contamination are obtained in the negative ion beam produced by charge exchange in H_2 gas. The heavy ion contaminant fraction was reduced to about 2 percent of an 8 to 10 mA negative ion beam by running the source at 30 Hz with a continuous gas flow of approximately 0.25 Torr-l/s. It is possible to exploit the capability of the present H^- source to produce large currents (approximately 10 mA) of specific heavy negative ions.

30469 STRIPPING IN FOILS AND GASES. Moak, C. D. (Daresbury Nuclear Structure Lab., Eng.). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1126-1132 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Equilibrium charge state distributions have been measured in many laboratories for both solids and gases with ions of a very large number of elements, and the range of ion velocities has been extended as new accelerators have become available. Many different charge changing cross sections contribute to any given equilibrium distribution so that direct measurement is preferable to computer predictions in cases where cross-section data are not known. Engineering difficulties due to short foil life under bombardment, especially at low energies, cause the choice of strippers in accelerators to be uncertain. Recent work on non-equilibrium charge distributions from small angle scattering in gas targets suggests that the intensity penalties incurred with gas stripping will be acceptable for a wide variety of applications. For large tandem accelerators, the use of gas strippers may depend upon the current-carrying capacity of the negative ion accelerator tube.

30470 LIFETIMES OF CARBON STRIPPING FOILS. Yntema, J. L. (Argonne National Lab., IL). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1133-1136 (Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The lifetime of carbon foils used as strippers in terminals of tandem electrostatic accelerators or as strippers prior to injection into post accelerators increases with increasing ion velocity. The usefulness of such strippers is affected by foil thickening processes due to hydrocarbon cracking and radiation induced effects as well as by pronounced increases in energy straggling from non-uniformity. The lifetime of the foils is substantially increased if the foil is heated during exposure to temperatures of about 400°C.

30471 STRIPPING STUDY FOR THE GANIL PROJECT. Frick, G. (Univ. Louis Pasteur, Strasbourg); Gehringer, C.;

Heusch, B.; Ricaud, C.; Wagner, P.; Baron, E. IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1137-1139(Apr 1976).

From international conference on heavy ion sources, Gatlinburg, TN, USA (27 Oct 1975).

The angular dispersions and energy straggling of Ni, I, and Au ions of energies between 0.4 and 0.9 MeV/nucleon were measured after bombardment of carbon foils in the range of 5 to 200 mu g/cm^2 in thickness. In these measurements the ions were detected in a Browne–Buechner spectrometer.

30472 HIGH DENSITY NEUTRAL GAS JET TARGET AS A WINDOWLESS STRIPPER. Bethge, K.; Feist, H.; Schopper, E.; Tietsch, W. (Univ., Frankfurt am Main). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1140-1142(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A windowless gas target was developed which uses gasdynamical focussing of a supersonic jet expanding into a region of static pressure of about 1 torr. Target thicknesses between a few mu g/cm^2 and about 200 mu g/cm^2 can be achieved. Continuous density measurement can be made by means of electron scattering or light attenuation.

30473 FORMATION OF He^- IONS IN COLLISIONS OF 60 TO 250 keV HELIUM BEAMS TRAVERSING CARBON FOILS. Kestelman, A. J.; Alonso, E.; Baragiola, R. A. (Comision Nacional de Energia Atomica, Bariloche, Argentina). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1143-1144(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Preliminary measurements of the charge equilibrium fraction for the negative component are presented for a He^+ beam traversing a 2 mu g/cm^2 carbon foil. This fraction decreases with energy with a value of about 2.5×10^{-4} at 60 keV and about 1×10^{-4} at 250 keV.

30474 SOURCES FOR NEGATIVE POLARIZED HEAVY IONS. Steffens, E. (Univ., Hamburg). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1145-1154(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A source for polarized lithium ions is described which uses the atomic beam principle. The polarized atoms are surface ionized to positive ions on a hot oxidized tungsten ribbon and then converted to negative ions in potassium vapor. Measurements on source parameters are discussed. The method of ionizing a polarized atomic beam by a surface can be extended to the other alkalides and probably to some other ions. A method of producing a polarized halogen beam using surface ionization to negative ions is proposed.

30475 CONFERENCE SUMMARY. Clark, D. J. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1166-1175(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A brief review is given of the main results presented at this conference. The sections are as follows: Highlights, General Observations, Fundamental Processes in Sources, Positive Ion Sources, Negative Ion Sources, Beam Formation and Emittance Measurements, Stripping, Accelerators and Experiments, and Future Prospects.

30476 AUTOMATIC EXTRACTION OF IONS FROM A HIGH-FREQUENCY ION SOURCE. Nikitin, V. A.; Yakushev, V. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1021-1023(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 19-20(1975).

A description and results of tests of a device for automatic extraction of ions from a high-frequency ion source are presented. The automatic regime is realized by introducing feedback with respect to the current of the source cathode and requires low sinusoidal modulation of the extracting voltage. By varying the power of the discharge, the beam current was controlled in the 90 to 1470 μA range with automatic preservation of the optimal conditions in the extraction system. The device was used on a 210 kV neutron generator.

30477 OBTAINING INTENSE BEAMS OF NEGATIVE HYDROGEN IONS. Kucherov, A. S.; Lebedev, L. S.; Orlovskii, A.V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1024-1026(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 21-23(1975).

Two methods of construction of a negative ion source based on a duoplasmatron are described: a source with an annular anode aperture, and a source with a hollow discharge. Currents above 200 μA are obtained for a beam of negative H^- ions at a current density 300 μA/mm^2 and electronic load currents of 2 to 4 mA. The possibility of obtaining large ion currents is analyzed.

30478 PRELIMINARY EVALUATION OF A MODIFIED MUELLER–HORTIG GEOMETRY NEGATIVE ION SOURCE USING A NEGATIVE ION SOURCE TEST FACILITY. Alton, G. D. (Oak Ridge National Lab., TN). Radiobiol. Radiother.; NS-23: No. 2, 1113-1117(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A negative sputter-type ion source of the Mueller–Hortig geometry is described which utilizes a positive surface ionization source. Among the ion beams which were produced are: Al-0.2 mu A; AlO^--3 mu A; Au^--6 mu A; C^--25 mu A; C_2^--20 mu A; Cl^--100 mu A; Cu^--0.5 mu A; CuO^--0.8 mu A; F^--40 mu A; I^--26 mu A; O^--30 mu A; Pt^--3 mu A; S^--44 mu A; TaO_2^--2 mu A. The yields of Cl^-, F^-, O^-, and S^- produced from gaseous or high vapor pressure compounds are observed to be sensitively dependent on the metallic surface from which they are generated—indicating an intermediate surface chemical effect. While the source produces very intense beams of the halogens, sulfur, and oxygen and relatively intense beams of the metallic oxides, there appears to be a need for additional surface cesium to ensure maximum negative ion yields from many of the elemental materials.

Ion Optics and Field Calculations

Refer also to abstracts 31010 and 31011.

30479 (CERN-Trans-74-5) PARTICLE SPIN MOTION IN A STORAGE RING WITH AN ARBITRARY FIELD. Derbenev, Ya. S.; Kondratenko, A. M.; Skrinskij, A. N. (AN SSSR, Novosibrisk. Inst. Yadernoj Fiziki). Mar 1974. 27p. (IYAF-2-70). INIS.

Translation from the Russian.

Results are presented for the problem of spin motion of polarized particles in a storage ring (or accelerator) with an arbitrary magnetic field, assuming only the existence of a closed orbit. The equations of the spin motion of relativistic particles are derived without invoking the 4-vector of polarization, and it is shown that there is always a periodic spin motion with a fixed polarization along the field in an almost uniform magnetic field. These results indicate prospects for controlling the polarization of both light and heavy particles in storage rings.

30480 (CERN-Trans-75-1) KINETICS OF ELECTRONIC COOLING. Budker, G. I.; Derbenev, Ya. S.; Dikanskij, N. S.; Parkhomchuk, V. V.; Pestrikov, D. V.; Skrinskij, A. N. (AN SSSR: Novosibirsk. Inst. Yadernoj Fiziki). Jan 1975. 11p. (In French). (IYAF-74-85). INIS.

Translation from the Russian.

The theory of electron cooling is discussed, qualitative solutions are obtained for the kinetic equation, and the results of numerical calculations are presented. The damping decreases in the angular dispersion and energy dispersion are obtained for heavy particle bunches.

30481 (CERN-Trans-75-3) FIRST EXPERIMENTS IN ELECTRONIC COOLING. Budker, G. I.; Dikanskij, N. S.; Kudelajnen, V. I.; Meshkov, I. N.; Parkhomchuk, V. V.; Pestrikov, D. V.; Skrinskij, A. N.; Sukhina, B. N. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). Jan 1975. 9p. (In French). (IYAF-74-87). INIS.

Translation from the Russian.

Preliminary experiments in electron cooling are described involving proton beams of about 65 MeV and electron beams of about 35 KeV. When the electron and proton speeds coincide within a factor of 10^{-3}, the following effects are observed: (1) a damping of the betatron oscillations; (2) a decrease of the energy dispersion of the proton bunches and the acceleration or deceleration of the protons by the electrons; (3) an increase in proton lifetime; and (4) the formation of 65 MeV neutral hydrogen atoms.

30482 (JINR-D-9-8076) ON THE PROBLEM OF THE CALCULATION OF TWO-DIMENSIONAL ELECTROSTATIC FIELDS. Dmitrievsky, V. P.; Kolga, V. V.; Trejbal, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 10p. INIS.

5 refs.; 4 figs.

30483 CALCULATION OF THE STEADY STATE OF ELECTRON RINGS IN AN EXTERNAL MAGNETIC FIELD. Budnyam, S.; Zhidkov, E. P. Zh. Vychisl. Mat. i Mat. Fiz.; 15: No. 5, 1241-1247(1975). (In Russian)

A method is described for the calculation of the steady state of electron rings in an external magnetic field. The method is based on a direct analog of the Newton method. The results of specific calculations are reported.

30484 BEAM DYNAMICS OF IPCR(RIKEN) HEAVY ION LINAC. Tonuma, T.; Yoshida, F.; Odera, M. (Inst. of Physical and Chemi-

cal Research, Wako, Japan). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1031-1034(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The IPCR heavy ion linac is of a Wideroe type, and its accelerating frequency is variable between 20 and 40 MHz. It is designed to accelerate ions with mass to charge ratios between 5 and 20 at these frequencies. Total voltage gain with six cavities is about 16 MV, the length of each cavity being three meters. Non-constancy of voltage between drift tube gaps against the change of a frequency gives large phase oscillations. Nevertheless, this results in very little effect on the transverse acceptance compared with that given by a constant distribution.

30485 SHAPING DEVICE OF A HIGH-CURRENT NANOSECOND ACCELERATOR. Bystritskii, V. M.; Okulov, B. V.; Usov, Yu. P.; Tsvetkov, V. I.; Shatanov, A. A. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1018-1020(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 16-18(1975).

The circuit of a shaping device for a high-current accelerator was proposed which has electrodes shaped in the form of disks. The experimental investigation of disk shaping lines was carried out on a model, while the numerical simulation was carried out on an MPT-9 analog computer.

30486 METHOD FOR PRECISION MEASUREMENT OF THE EDGE DISPLACEMENT OF A BREMSSTRAHLUNG SPECTRUM. Karabekov, I. P.; Martirosyan, M. A.; Ovakimyan, S. S. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1034-1036(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 28-30(1975).

A method is proposed for measuring the stability of the edge of the bremsstrahlung spectrum in γ beams of electron accelerators having a resolution amounting to $\sim 10^{-4}$ of the value of the maximum energy of the quanta. Results are presented of an experimental investigation of the method, as well as the principal computation formulas which allow determination of the sensitivity and design parameters of the limiting-energy sensor.

30487 MEASUREMENT OF RAPID INTENSITY FLUCTUATIONS OF THE RADIATION OF PULSED ACCELERATORS OF CHARGED PARTICLES. Balamatov, N. N. Meas. Tech. (USSR) (Engl. Transl.); 18: 1239-1241(Aug 1975).

Translated from Izmer. Tekh.; 18: No. 8, 83-84(Aug 1975).

When a statistical distinction of the yield of nuclear reactions of various multiplicities is to be made in experiments, one must measure intensity fluctuations of an accelerator beam and reduce the influence of the fluctuations upon the experimental results. The selection of parameters and of systems for stabilizing and optimizing the accelerator intensity, which are widely used at present, is dependent upon the intensity fluctuations of the radiation. A measurement method is described which makes it possible to obtain the average value and the dispersion of rapid fluctuations of a parameter relative to the frequency of the accelerator duty cycles.

30488 RADIATIVE ENERGY LOSS OF A BEAM IN THE HIGHER PASSBANDS OF AN IRIS-LOADED WAVEGUIDE. Batygin, Y.V.; Grishaev, I.A.; Dovbnya, A.N. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Tech. Phys. 20: No. 8, 1110-1112 (Aug 1975).

The contribution of the higher passbands of an iris-loaded waveguide to the energy loss due to the radiation of symmetric waves by a train of relativistic charges is analyzed for the linear accelerator of the Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR. The dispersion properties of the structure are taken into account by substituting the experimental data into the appropriate equations. With relatively few charges (up to 20) the higher passbands make an important contribution to the total radiative energy loss of the beam. (auth)

30489 SPACE-CHARGE LIMITATION IN A HIGH-CURRENT BETATRON DUE TO THE NEGATIVE-MASS EFFECT. Gromov, Y.A.; Moskalev, V.A.; Pogorelov, V.I. (Scientific-Research Institute of Nuclear Physics, Electronics, and Automation, S. M. Kirov Tomsk Polytechnical Institute). Sov. Phys.—Tech. Phys. 20: No. 8, 1113-1114 (Aug 1975).

Experiments demonstrate a longitudinal instability of the negative-mass type in a high-current betatron at the time electrons are injected into the accelerating chamber. This instability limits the charge which can be captured in the acceleration mode; hence, in the design of high-current betatrons, the charge which can be accelerated must be consistent with the threshold number of particles for the onset of this instability for a given injected-electron energy and magnetic field index. (auth)

30490 EXPERIMENTAL INVESTIGATION OF THE DISTRIBUTION OF THE MICROWAVE POWER FLUX IN A PLASMA WAVEGUIDE. Egorov, A. M.; Kivshik, A. F. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 20: No. 3, 134-135(Mar 1975).

Translated from Radiotekh. Elektron.; 20: No. 3, 657-659 (Mar 1975).

An experimental investigation was made of the redistribution of microwave power in a plasma waveguide used in slow-wave systems for charged-particle linear accelerators. The microwave power flux distribution was determined inside and outside the plasma pinch as a function of charge density, plasma diameter, and external magnetic field strength. (PMA)

30491 SELECTING THE PARAMETERS OF A MAGNETIC ONDULATOR. Nikitin, M. M.; Medvedev, A. F. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 85-90(1975). (In Russian).

A study is made of the total power of ondulatory radiation as a function of the construction parameters of the ondulator and its feed current. The magnetic field in the ondulator and the optimal dimensions of the ondulator are calculated for maximum strength of the magnetic field per unit length of the system. It is shown that the total radiative power of the charged particles depends on the periodic length of elements in the ondulator.

Storage Rings

30492 (AD/A-005784) OPERATION OF THE SYNCHROTRON RADIATION CENTER OF THE UNIVERSITY OF WISCONSIN. Final Report, 1969-1974. Rowe, E. M. (Wisconsin Univ., Stoughton (USA). Physical Sciences Lab.). 1975. Contract F44620-70-C-0029. 65p. NTIS $4.25.

A report is given of the operation of a 240 MeV electron storage ring as an intense source of synchrotron radiation for a wide variety of investigations in the far ultraviolet and soft x-ray region of the electromagnetic spectrum. The performance of the storage ring was improved, and a number of optical instruments of advanced design and performance were developed. Studies of the orbit dynamics of the circulating electrons in the storage ring were carried out, and the results of these studies were applied to the storage ring to bring about a large increase in stored beam current and beam lifetime. A 44 MeV microtron was designed and built to replace the original storage ring injector, resulting in improved reliability of the storage ring and a reduction in operating costs and power demand. (GRA)

30493 THERMAL DESORPTION OF GASES FROM ALUMINUM ALLOY Al 6061, THEIR RATES AND ACTIVATION ENERGIES. Halama, H.J.; Herrera, J.C. (Brookhaven National Laboratory, Associated Universities, Incorporated, Upton, New York 11973). J. Vac. Sci. Technol. 13: No. 1, 463-466 (Jan 1976).

The use of Al in the construction of the vacuum chamber of intersecting proton storage rings has several advantages over the use of stainless steel. We have, therefore, undertaken UHV studies on long pipes made of Al alloy 6061 to see whether this material could be used in the proposed proton intersecting storage accelerator facility ISABELLE at Brookhaven. The outgassing rates, measured by two different methods, are compared for several surface treatments and three bakeout temperatures. The lowest outgassing rate of less than 1×10^{-14} Torr l s^{-1} cm^{-2} (1.33×10^{-12} Pa l s^{-1} cm^{-2}) was obtained with Ar and O_2 discharge cleaning. The residual gas in the pipe contained more than 99% H_2 with traces of CO and CO_2. By observing the temperature dependence of the desorption of these gases, we have measured the heat of diffusion of H_2 ($E_{H_2} = 10.5 \pm 1.0$ kcal/mole) and the thermal activation energies of CO ($E_{CO} = 29 \pm 2$ kcal/mole) and CO_2 ($E_{CO_2} = 25 \pm 2$ kcal/mole). Ar, with a peak desorption at 280° - 300°C, also appears to be embedded in the metal. Since all commercially available UHV equipment uses stainless steel flanges, we have investigated the behavior of the stainless steel to Al transitions up to 350°C. (auth)

Experimental Facilities

Refer also to abstracts 28587, 29348, 29349, 29352, 29354, 29373, 29378, 29379, and 30424.

30494 (IAEA-171, pp 1-22) PRACTICAL AND RESEARCH ASPECTS OF BEAM-FOIL SPECTROSCOPY. Bashkin, S. 1975.

From panel meeting on the utilization of low energy accelerators; Zagreb, Yugoslavia (30 Sep 1974).

In utilization of low energy accelerators. (International Atomic Energy Agency, Vienna (Austria)).

The application of a heavy-ion accelerator to research in beam-foil spectroscopy requires certain capital equipment which is somewhat unorthodox when viewed from the standpoint of conventional, low-energy nuclear physics. It is necessary that people who wish to expand their accelerator work to include beam-foil studies understand the nature and cost of such major apparatus. We will survey the equipment needs, starting with the particle analyzer at the output of the accelerator and including the equipment used in a variety of beam-foil experiments. Electronic and computer devices will not be discussed since they are essentially identical with those employed in nuclear

studies. Considerable attention will be given to optical spectrometers and spectographs including simple instruments which might be used by a laboratory just getting started in beam-foil research, or which has limited financial resources. Attention will be given to the production and use of the exciter foils. Some typical beam-foil experiments having to do with the excitation, detection, and analysis of spectral lines from electronic levels in multiply-ionized atoms, and also with the measurement of the mean lives of such levels are discussed. Some of the special properties of the beam-foil light source as regards the population of the magnetic sub-states of a given level are reviewed. Recent work on the character of the emitted light is presented. That work deals specifically with the origin of the polarization of the light. The relevant experiments involve varying the angle between the plane of the exciter foil and the particle velocity. (auth)

30495 THERAPY BY STATIONARY PHOTON FIELDS FROM A 42 MeV BETATRON USING WEDGE FILTERS. Wicke, L.; Kaercher, K. H.; Naesiger, H.; Prokosch, E. (Vienna Univ. (Austria). Strahlentherapeutische Klinik; Vienna Univ. (Austria). Inst. fuer Klinische Strahlenbiologie). Strahlentherapie; 150: No. 5, 468-474(Nov 1975). (In German).

The dose distribution in photon beams from a 42 MeV betatron using wedge filters of lead with different angles of slope is described. The wedge coefficient to be considered at a field size of 10 × 10 cm is given. The scope for isodoses modified by wedge filters is discussed with regard to stationary-field photon therapy. (DE)

30496 APPARATUS COMPLEX FOR STUDYING SHORT-LIVED ISOTOPES AND NUCLEAR ISOMERS. Kovrigin, O. D.; Burminskii, V. P.; Sychikov, G. I. Prikl. Yad. Spektrosk.; No. 5, 106-110(1975). (In Russian)

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The experimental installation used for studying the radioactive decay of short-lived isotopes and isomers and for confirming their mass formula is described. The reaction products to be studied were induced by protons, deuterons, ^{3}He beams, and α particles accelerated by the isochronous cyclotron. The isotopes could be studied at two places in the experimental arrangement: in the cyclotron chamber in the discharge flange of the chamber of the first rotating magnet and in the experimental chamber at the focus of the subsequent pairs of quadrupole lenses. The operation of the system is described in detail. (JSR)

30497 OPTIMUM PRODUCTION OF 14-MeV NEUTRONS FROM TRITIUM TARGETS. Kvasnicka, J. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). Fakulta Jaderna a Fysikalne Inzenyrska). Acta Polytech. (Prague), IV; No. 5, 129-132(1973). (In Czech)

From 2nd scientific conference on the Czech Technical University; Prague, Czechoslovakia (12 Jun 1973).

30498 METHOD OF ADJUSTING A MULTISTAGE MAGNETO-OPTICAL CHANNEL. Kats, M. M.; Breev, V. M. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1014-1017(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 13-16(1975).

A method is proposed for adjusting a multistage magnetooptical channel which uses the spectrometric capabilities of the second and subsequent stages of the channel. At the first focus of the channel, a "scatterer" is introduced during the adjustment time, and the total beam width at the second focus is minimized for particles passing through a narrow collimator mounted at the first focus. A scattering filter or a magnet having a variable field may serve as the scatterer. The dependence of the total beam width on the channel parameters is obtained in the presence of the "scatterer." The procedure for adjusting the channel is modeled on an electronic computer.

30499 COMPACT SOLID-HYDROGEN TARGET. Barkov, L. M.; Zolotorev, M. S.; Lebedev, P. K.; Okhapkin, V. S.; Smakhtin, V. P. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 4, 1032-1033(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 4, 27-28(1975).

The construction of a solid-hydrogen target is described. The target is placed in the 8 mm gap of a pulsed megagauss magnet which undergoes destruction during experiments on the measurement of the magnetic moments of hyperons.

30500 COMPUTING AT CERN. CERN Cour.; 16: No. 3, 84-86(Mar 1976).

A discussion is given of the present central computing service at CERN, trends in computer use—volume, data storage, and accessibility—and the future computing facilities at CERN. Additional central computing capacity will be provided to cope with the volume of computing which will be generated by the research program. High density magnetic tapes and possibly a mass storage device should handle data storage problems, and a high speed data communications will provide more on-line computing power. (PMA)

30501 NEUTRINO BEAM CHANNEL OF THE INSTITUTE FOR HIGH ENERGY PHYSICS. Eremenko, E. V.; Mukhin, A. I.; Mysnikov, K. P.; Samoilov, A. V.; Tushabramishvili, K. Z. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). pp 331-347 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

The neutrino channel at Serpukhov Institute for High Energy Physics is described. Preliminary data on the characteristics of some systems in the channel are given. (FR)

30502 DESIGN OF THE FERMILAB NEUTRINO REMOTE TARGET MAINTENANCE SYSTEM. Simon, J.; Grimson, J.; Lindberg, J.; Theriot, D. (Fermi National Accelerator Lab., Batavia, IL). Conf. Remote Syst. Technol., Proc.; 23: 32-40 (1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A system of interchangeable targetry on rail transporters has been in use for four years. This design concept allows rapid interchange of radioactive target equipment with a minimum of exposure to operating personnel. Separate maintenance facilities equipped with a variety of remote handling equipment, including a mobile electric master-slave manipulator, are used to construct, maintain, and modify targetry and beam-line equipment concurrent with the 400-GeV accelerator beam operation.

30503 DESIGN OF THE FERMILAB NEUTRINO HORN TRAIN SYSTEM REFERENCED TO RADIOACTIVE MAINTENANCE. Grimson, J.; Lindberg, J.; Simon, J.; Theriot, D. (Fermi National Accelerator Lab., Batavia, IL). Conf. Remote Syst. Technol., Proc.; 23: 41-50(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A high-energy physics device known as a Horn, which operates at 140,000 A and 8 kV, has unique problems in keeping it operationally serviced after being exposed to 300- to 400-GeV protons and 1 to 5 x 10^{13} protons per pulse. A modular system consisting of two horns, one cooled by a pulsed water spray and the other by forced air cooling, along with their associated utilities and instrumentation, was designed for primary servicing using electric master-slave manipulators and TV viewing.

30504 MONITOR: A VERSATILE REMOTE HANDLING SYSTEM. Horne, R. A.; Ekberg, E. L. (Los Alamos Scientific Lab., NM). Conf. Remote Syst. Technol., Proc.; 23: 242-246 (1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

MONITOR, constructed from relatively cheap commercial components, is a straightforward, remotely operated handling system intended to work on components in the Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF) external beam line or elsewhere. It can be towed or lifted into position, then hard-wire controlled from a distance, using television.

30505 LONG-RANGE, HIGH-SPEED REMOTE HANDLING AT THE CERN 26-GeV PROTON SYNCHROTRON. Horne, R. A.; Ellefsplass, M. (CERN, Geneva). Conf. Remote Syst. Technol., Proc.; 23: 247-251(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A high-speed remote handling system built for the CERN proton synchrotron includes an electronic servo master-slave manipulator, the slave being mounted on an overhead movable bridge with three TV cameras, two of them on articulating telescopic arms, transmitting closeup and wide-angle pictures to the master station which may be several hundred meters away and without direct view of the working zone. The manipulator slave, the cameras, lights, and various bridge and hoist movements are all controlled from the master station.

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

30506 SPACE RESEARCH XV. Proceedings of the Seventeenth Plenary Meeting of COSPAR Held in Sao Paulo, Brazil, June 1974. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975). 752p. (CONF-7406116-).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974).

Individual abstracts are given for the 64 papers presented. (BJG)

For abstracts of individual papers see: 30512, 30543, 30673–30675, 30707–30713, 30769–30771, 30855–30862, 30882–30919, and 30979–30981.

Cosmic Radiation

Refer also to abstracts 29261, 29262, 29342, 29365, 29366, 30506, 30674, 30675, 30788, 30842, 31227, 31245, 31405, and 31406.

30507 (AD/A-007839) STUDY OF COSMIC RADIATION NEAR THE EARTH'S NORTH GEOMAGNETIC POLE. Final Report, 1 February 1970–28 January 1975. Pomerantz, M. A. (Bartol Research Foundation, Swarthmore, Pa. (USA)). 18 Feb 1975. Contract F19628-70-C-0190. 234p. NTIS $7.50.

The report discusses cosmic ray intensity observations at AFCRL geopole station and analyzes cosmic ray intensity variations, covering modulations and anisotropies, solar cosmic rays, long-term relationships between solar activity and cosmic ray phenomena, and neutron multiplicity studies. (GRA)

30508 (FRNC-TH-569) NUCLEAR INTERACTIONS BETWEEN COSMIC RADIATION AND INTERSTELLAR GAS, AND NUCLEOSYNTHESIS OF LITHIUM, BERYLLIUM, AND BORON. Meneguzzi, M. (Paris-7 Univ., 75 (France)). 1975. vp. (In French). INIS.

The effects of nuclear interactions between the nuclei of cosmic radiation and those of interstellar gas were studied. The variation in the chemical composition of cosmic radiation with energy shows that the quantity of matter it passes through decreases between 1 and 100 GeV/nucleon from 6 to 1g/cm^2 approximately. The chemical and isotopic composition for C, N and O suggests that the relative abundances of these nuclei at the source are much the same as the universal abundances except for the ratio C/O, higher by about a factor 1.5 in cosmic radiation sources. The enrichment of interstellar gas in light elements Li, Be and B was calculated. The value obtained accounts well for the universal abundances of the four isotopes ^{6}Li, ^{9}Be, ^{10}B, ^{11}B independently of the model used. It may be assumed that large fluxes of low-energy cosmic rays exist in the remains of supernovae and that ^{7}Li is produced in these objects and then spread out in the galaxy. The objects could be extended sources of nuclear γ's, which are observable, but the same process proves unable to produce sufficient quantities of the very heavy proton-rich elements of dubious origin. Inelastic collisions or spallation reactions between cosmic and interstellar gas nuclei induce a quantity of nuclear γ ray emission not necessarily undetectable. The position flux of a few MeV from the β^+ disintegration of unstable spallation products is too low on the other hand to give an estimate of the low-energy cosmic radiation flux in the interstellar medium. (FR)

30509 AIR PRESSURE CORRECTION FOR THE NEUTRON MONITOR REGISTRATION OF COSMIC RADIATION ON THE JAUNGFRAU SADDLE. *Mini, R.; Debrunner, H.; Flueckiger, E.* (Univ., Bern). Helv. Phys. Acta; 48: No. 4, 495-500(1975). (In German).

In order to obtain an evaluation of the solar wind–cosmic radiation and solar wind–magnetosphere–cosmic radiation interactions from neutron monitors of cosmic radiation it is necessary to convert the measurement results to constant atmospheric conditions. Six methods for this conversion are analyzed. The results show that the mean barometric coefficient of an observation period cannot be determined by a simple linear regression applied to the total data. In order to obtain the accuracy of the pressure correction necessary for the interpretation of cosmic radiation data exacting analyses must be made. (JSR)

30510 THE ELECTROMAGNETIC BACKGROUND: LIMITATIONS ON MODELS OF UNSEEN MATTER. Eichler, D.; Solinger, A. (Physics Department and Center for Space Research, Massachusetts Institute of Technology). Astrophys. J. 203: No. 1, 1-5 (1 Jan 1976).

The existence of bound systems implies the release of energy associated with their formation. Estimating the fraction of this energy which appears in observable diffuse places restrictions on various theories involving high binding energy densities of seen or unseen matter. For example, any theory involving discrete sources to explain a particular background must also consider the binding energy released in the formation of the hypothesized sources. The potency of pulsars and white dwarfs as cosmic-ray sources is severely limited by these considerations. We also find: (1) The amount of unseen matter in the form of burned-out stars or neutron stars must be well below that needed to bind the Universe. (2) Black holes, if not primordial, are restricted to an extremely narrow range of parameters if they are supposed to bind the Universe, and are thus unlikely candidates. All these generalizations can be violated, but only if the amount of energy in the infrared background exceeds that in the rest of the observed electromagnetic backgrounds by more than an order of magnitude. (auth)

30511 MEASUREMENT OF THE LOW-ENERGY DIFFUSE X-RAY BACKGROUND. Yentis, D. J. New York; Columbia Univ. (1975). 168p. University Microfilms Order No. 76-1354. Thesis (Ph. D.).

In a rocket experiment flown in February 1970, data were obtained in the energy range 0.1 to 0.28 keV which establish the existence of a soft, diffuse x-ray flux exceeding in intensity an extrapolation to low energy of the power-law spectrum observed above 1 keV. The experiment utilized an x-ray focusing collector and filters to ensure that detected events were due only to soft x rays and not to ultraviolet radiation or charged particles. The x-ray spectrum incident at the earth at high galactic latitude (+60°) is found to be steeply rising at energies less than 0.28 keV with an integrated energy flux of 29 keV sec^{-1}cm^{-2}sterad^{-1} between 0.1 and 0.28 keV. Data obtained in a single slow scan of the Galaxy, beginning near the plane in the anticenter direction and ending at galactic latitude +60°, show a qualitative correlation with 21-cm hydrogen data only from intermediate (+30°) to high galactic latitude. To explain transformation can be considered as a generalization of the Addition Theorem of cylindrical wave functions. The problems of the reflection of a plane wave (at angular frequency ω) from a rigid wall in rectilinear harmonic motion (at angular frequency Ω, $\Omega \ll \omega$), and the reflection of a propagating duct mode from a piston in rectilinear harmonic motion are solved by the transformation method. The problem of a monopole sound source in a rectangular duct with one closed termination fixed, and the other closed termination oscillating at large amplitude is solved in two steps. It is shown that the sound pressure represented by the sidebands (of angular frequency $\omega+\nu\Omega$ where $\nu \neq 0$) has no effect on the power output of the sound source (of angular frequency ω). The results of this theoretical model agree with the experimental results of a moving sound diffuser in a reverberation room. It can be used for the further investigation concerning the very complicated effects of a moving sound diffuser in a reverberation room. (Diss. Abstr. Int., B)

30512 HIGH ENERGY γ RAY ASTRONOMY. Fichtel, C. E. (Goddard Space Flight Center, Greenbelt, MD). pp 699-714 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

From the study of the intensity of the high energy γ radiation as a function of galactic longitude, it is already clear that cosmic rays are almost certainly not uniformly distributed in the galaxy and are not concentrated in the center of the galaxy. The galactic cosmic rays, and accordingly the magnetic fields to which they are tied, appear to be correlated with galactic structural features, presumably by the gravitational attraction of the matter in the arm segments and the clouds. A strong excess of high energy γ rays has been observed from the Vela region. If this excess is attributed to cosmic rays released from the Vela supernova interacting with the interstellar matter in that region, about 3×10^{50} ergs would have been released by that supernova in the form of cosmic rays. On the extragalactic scale, the diffuse celestial γ ray flux has both an intensity and an energy spectrum which suggest a possible cosmological origin, although other possible explanations cannot be excluded at this time. The low intensity of the diffuse radiation above 150 MeV also shows that the cosmic rays cannot be universal in a closed universe theory. (auth)

30513 BALLOON-BASED MEASUREMENTS OF THE COSMIC BACKGROUND RADIATION. Mather, J. C.; Richards, P. L.; Woody, D. P. (Univ. of California, Berkeley). IEEE Trans. Microwave Theory Tech.; MTT-22: No. 12, 1046-1048(Dec 1974).

A balloon-borne liquid-helium-cooled spectrometer to measure

the cosmic background radiation in the 3–18-cm^{-1} region has been developed and flown. It features a cooled horn antenna, a polarizing Michelson interferometer, and a germanium bolometer. These design features and the performance of the instrument are discussed. (auth)

30514 CONSISTENCY OF COSMIC-RAY COMPOSITION, ACCELERATION MECHANISM, AND SUPERNOVA MODELS. Hainebach, K.L.; Norman, E.B.; Schramm, D.N. (Enrico Fermi Institute, The University of Chicago). Astrophys. J. 203: No. 1, 245-256 (1 Jan 1976).

It is shown that a consistent picture of cosmic-ray composition can be obtained by synthesizing the observed cosmic-ray abundances with the acceleration mechanisms of Scott and Chevalier or Jokipii, and the presupernova models of Arnett and Schramm, with explosive processing. If this model is valid, then it is possible to estimate (1) the location of the supernova "mass cut," (2) possible anomalies in the yet to be accurately observed cosmic-ray iron isotopic ratios, (3) the cosmic-ray ratio of *r*- to *s*-process elements, and (4) the time between the supernova explosion and the acceleration of the cosmic rays. (auth)

30515 COSMIC RAY EFFECTS INDUCED IN A ROCK EXPOSED ON THE MOON OR IN FREE SPACE: CONTRAST IN PATTERNS FOR 'TRACKS' AND 'ISOTOPES'. Bhattacharya, S. K.; Goswami, J. N.; Gupta, S. K.; Lal, D. (Tata Inst. of Fundamental Research, Bombay). Moon; 8: 253-286(1973).

Analytical studies are reported here for two cosmogenic effects due to low energy particles in extraterrestrial samples: Formation of latent chemically etchable tracks in crystalline materials due to solid state damage as a result of ionization losses suffered by multicharged cosmic ray nuclei, and production of low threshold isotopes due to nuclear interactions of solar cosmic ray particles. The present analytical treatment is different from those previously reported and is more directly applicable to recent studies of low energy cosmogenic effects in meteorites and in lunar samples. Irradiation of ellipsoidal rocks in space and on the Moon is considered. In the latter case, different irradiation geometries corresponding to different burials in the regolith are also considered. It is shown that results of irradiation of an object on the surface of a parent body differ from that of an object in free space in more complex manner than a uniform reduction by a factor of two due to the change over from 2π to 4π irradiation. Isocontours for "tracks" or "isotopes" are found to be markedly different in the two cases. Thus, the irradiation geometry must be explicitly taken into account in interpreting low-energy cosmogenic effects in lunar rocks. Simultaneous analyses of tracks and radioisotopes of different half-lives should allow one to establish principal irradiation geometries both for meteorites and lunar samples. (auth)

30516 ENERGY SPECTRUM OF PARTICLES ACCELERATED IN THE NEIGHBORHOOD OF A LINE OF ZERO MAGNETIC FIELD. Bulanov, S.V.; Sasorov, P.V. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR). Sov. Astron.—AJ 19: No. 4, 464-468 (July 1975).

A study is made of the acceleration of chared particles in a hyperbolic magnetic field and uniform electric field, these fields arising from the decay of a neutral current sheet. The acceleration process consists of direct acceleration by the electric field in the nonadiabatic region near the zero line and betatron acceleration in the drift region. The characteristic energy of the accelerated particles is found in the nonrelativistic and ultrarelativistic limits. At high energies, the spectra are exponential. (auth)

30517 PROLONGED CONTAINMENT OF FAST PARTICLES IN A MAGNETIC TRAP. Uralov, A.M. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 19: No. 4, 469-472 (July 1975).

A study is made of the influence of the cone instability due to anisotropy in the distribution of thermal ions of a plasma on the containment duration of fast particles captured by a trap. Whistlers transfer energy from the plasma to the transverse degrees of freedom of the trapped particles, whose total energy is negligible compared with the energy of the plasma in the trap. This question is directly related to the problem of containment of cosmic rays on the Sun and in the Earth's magnetosphere. (auth)

30518 CALCULATION OF THE ENVIRONMENTAL FLUX AND ABSORBED DOSES FOR GEOS SATELLITE. Bourrieau, J.; Philippon, J. P. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 31—Toulouse (France). Centre d'Etudes et de Recherches). pp 65-78 of Evaluation of the Effect of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974). (In French)

From international conference on evaluation of the effect of space environment on materials; Toulouse, France (17 Jun 1974).

Evaluation of ionizing radiation damage to different materials is a problem which must be solved in order to define a space mission. Two evaluations are necessary: the particle flux received by the satellite and the absorbed doses by the different components. These two types of calculation are presented and apply to the GEOS experiment. (FR)

30519 SIMULATION OF THE COSMIC DUST AND MICROMETEORITE PARTICLE STREAMS. Akishin, A. I.; Kiryukhin, V. P. pp 171-180 of Evaluation of Space Environment on Materials. International Conference, Toulouse, June 17-21, 1974. Toulouse, France; Centre National d'Etudes Spatiales (Jun 1974).

From international conference on evaluation of space environment on materials; Toulouse, France (17 Jun 1974).

During the orbital flights around the earth and other planets space vehicles interact with micrometeorite particles with 10^{-6}-10^{-14}g masses and 8-72 km/sec velocities. A simulator is described in which charged aluminium and nickel particles (01-5 μ in size) are accelerated and hit the metallic inner wall of a spherical chamber. The intensity of light flashes in case of impact of accelerated aluminium particles with a 10^{-15} g mass and 30-50 km/sec speed was measured using a FEU-36 photomultiplier. The coefficient of conversion of the kinetic energy of an accelerated microparticle into luminous radiation burst was 10^{-2}%. The accelerated microparticle beam with a (40-150) m/sec speed may be used to simulate a Martian dust storm. The beam intensity may be raised up to several hundreds of particles per second. (FR)

30520 ORIGIN AND PROPAGATION OF COSMIC RAYS. Cesarsky, C. J. (CEA Centre d'Etudes Nucleaires de Saclay, 91—Gif-sur-Yvette (France). Service d'Electronique Physique). Sci. Tech. Rev.; 1: No. 1, 23-33(1975).

A short review of the origin and propagation of cosmic rays is presented, which emphasizes the main unanswered questions in these fields and points to possible experimental tests to help resolve them. (FR)

30521 NEW LIGHT ON COSMIC-RAY ASTRONOMY. Biswas, S. (Tata Inst. of Fundamental Research, Bombay (India). Cosmic-Ray and Solar Physics Group). Nucl. India; 13: No. 6, 1-3, 8(Feb 1975).

A cosmic ray experiment conducted successfully in the Skylab spacecraft with a detector module exposed for 73 days outside it is reported. The detector module consists of an assembly of Lexan polycarbonate sheets which register the tracks of cosmic ray particles. These dielectric detectors can withstand the radiation environment for a long time without any significant loss in sensitivity. The compact detector module has a surface area of 350 cm^2 and an exposure factor 100 times higher than that in a typical balloon flight. Analysis of the data shows the major part of the flux is due to low energy (partly ionized C.N.O. group, mostly oxygen) ions. The discovery of low energy ions adds a new component to cosmic radiation. These observations will be a key to further studies on the origin of cosmic radiation.

30522 NEUTRON-PROTON FORWARD ELASTIC SCATTERING FROM 58 TO 391 MeV. Bersbach, A.J.; Mischke, R.E. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540); Devlin, T.J. Phys. Rev. D 13: No. 3, 535-553 (1 Feb 1976).

Elastic neutron-proton differential cross sections have been measured between 58 and 391 MeV incident neutron energy at angles in the center-of-mass system from 11° to 54°. Neutrons were scattered from a liquid-H_2 target and detected in liquid scintillators. The incident energy of each detected neutron was determined from its time of flight. The data were normalized by placing the detector in the beam. The results are generally consistent with previous data and with the predictions of phase-shift analysis but are of improved accuracy. (auth)

30523 ABSOLUTE LOW-LATITUDE SEA-LEVEL MUON INTENSITY AT LARGE ZENITH ANGLE. Bhattacharyya, D.P. (Indian Association for the Cultivation of Science, Jadavpur, Calcutta-700032, India). Phys. Rev. D 13: No. 3, 566-570 (1 Feb 1976).

The absolute sea-level cosmic-ray muon intensity has been estimated by using a flash-tube range spectrograph at axial zenith angles 75°–85° W near the geomagnetic equator in the cutoff-momentum region 0.4 GeV/*c*. The measured absolute muon intensity agrees with the results calculated in the manner of Ashton *et al.*, assuming $K/\pi = 0$ for zenith angles up to 81° W and $K/\pi = 0.4$ for 85° W. The angular distribution of muons obeys a cosine-square law. The measured absolute integral muon spectrum at axial zenith angle 81° W in the cutoff-momentum interval 0.4–3 GeV/*c* agrees with the theoretical spectral shape calculated in the manner of Barrett *et al.* (auth)

30524 SEARCH FOR COSMIC-RAY ANISOTROPIES USING NUCLEAR EMULSIONS. Cottrell, D.; Anselmo, J.; Robinson, T. (Physics Department, San Diego State University, San Diego, California 92182). Phys. Rev. D 13: No. 5, 1147-1149 (1 Mar 1976).

Directions of fast particles from nuclear interactions were measured in

nuclear emulsion fixed in celestial coordinates with a 1° accuracy. The purpose was to determine any anisotropy and to determine the existence of a neutral particle of high cross section. Neither were found. (auth)

30525 MEASUREMENTS OF THE COSMIC BACKGROUND RADIATON THROUGH THE 1.0–1.4-mm ATMOSPHERIC WINDOW. Dall'Oglio, G.; Fonti, S.; Melchiorri, B.; Melchiorri, F.; Natale, V. (Laboratorio TeSRE-CNR, Infrared Section of Firenze, Firenze, Italy); Lombardini, P.; Trivero, P.; Sivertsen, S. Phys. Rev. D 13: No. 5, 1187-1194 (1 Mar 1976).

Observations carried out from an Alpine location (3500 m) using a Dicke-type radiometer with a broad-band germanium bolometer have proved that the cosmic background radiation in the 900-1400 micron band can be measured from mountain altitudes with a precision comparable with that obtained in the 3.3-mm band. The inaccuracy in the measurements is attributed to calibration rather than to the atmospheric disturbances. The upper limit of 2.7 °K observed is more stringent than that of previously reported balloon-borne and rocket-borne observations in the same band. (auth)

30526 AN OBSERVATION OF THE DIFFUSE SOFT X-RAY/EXTREME-ULTRAVIOLET BACKGROUND. Cash, W.; Malina, R.; STern, R. (Space Sciences Laboratory, University of California, Berkeley). Astrophys. J. Lett. 204: No. 1, L7-L11 (15 Feb 1976).

Observations of diffuse radiation in the 114–150 Å and 44–120 Å bands have been made with rocket-borne proportional counters. The small collecting area, large field of view (55° FWHM) counters observed areas of sky near $l=150°$, $b=-15°$ and $l=189°$, $b=3°$. We observed a flux of 0.125 photons cm^{-2} s^{-1} sr^{-1} eV^{-1} at 180 eV, consistent with previous measurements, and a flux of 3.2 photons cm^{-2} s^{-1} sr^{-1} eV^{-1} at 100 eV, indicating a steeply rising spectrum. The spectrum presented by Yentis *et al.* for a different part of the sky predicts fluxes $4(\pm 1)$ times higher at 180 eV and $7(\pm 1.7)$ times higher at 100 eV. The experimental data have been used to place constraints on simple models for galactic origin of the 50–150 Å background. An upper limit on the space density of white dwarfs at $T \gtrsim 10^5$ K is obtained. (auth)

30527 ANGULAR VARIATIONS OF COSMIC BACKGROUND SPECTRA IN METER WAVE RANGE ALONG DECLINATION $\delta = 15°30'$. Belyaev, P. P.; Getmantsev, G. G.; Zinichev, V. A.; Rakhlin, A. V.; Tarasov, A. F.; Tokarev, Yu. V. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 19: No. 1, 12-18(1976). (In Russian).

The results of measurement of the effective temperature of the cosmic background radiation at 79 and 115 MHz along declination angle $\delta = 15°30'$ using a parabolic mirror of 30×50 m^2 RT UKWD radio telescope are presented. Identical, geometrically similar feeds are employed at both operating frequencies. The side lobe radiation is taken into account. The temperature spectral index of the total cosmic radio emission in the main lobe of the antenna β_m is calculated. A decrease in β_m is noted from 2.55 in the cold part of the sky at right assension $\alpha \approx 12^h$ to 2.42 in the region of the North auroral spur ($\alpha \approx 16^h30^m$) and up to 2.35 in the Galaxy plane ($\alpha \approx 19^h$). (auth)

Stars

Refer also to abstracts 29190, 29191, 30510, 30514, 30517, 30526, 30676, 30677, 30681, 30685, 30687, 30689, 30690, 30726, 30781, 30782, 30784, 30792, 30797, 30808, 30813, 30817, 30820, 30822, 30823, 30832, 31121, 31453, 31605, and 32105.

30528 (INIS-mf-1888, pp 86-108) BETATRON ACCELERATION IN THE LARGE SOLAR FLARE OF AUGUST 4, 1972. Chapter 4. Brown, J. C.; Hoyng, P. 23 Jun 1975.

This chapter will be published in Astrophys. J.; 28 refs., 6 figs.

In studies on hard x-ray emission from solar flares and on cyclotron radiation from a cold magnetoplasma. (Rijksuniversiteit Utrecht (Netherlands)).

The problem of diagnosing flare particle acceleration mechanisms from hard x-ray bursts is discussed and it is argued that the electron trap model of bursts is more amenable to observational investigation at present than models of thick-target type. It is then shown that data for the large x-ray burst of August 4, 1972 are consistent with the source electrons being trapped in a very large vibrating coronal magnetic bottle. Furthermore, the observations show that the burst time profile is not dominated by collisional losses. It is proposed instead that the entire profile is essentially determined by betatron action of the varying trap field on the electrons. This betatron model is then analyzed in detail and shown to predict very well the observed correlation of electron flux and spectral index in this event when it is supposed that the electrons are initially produced by a brief unspecified acceleration. Comparison of the model with observations permits inference of the approximate form of magnetic field evolution in the trap.

30529 (INIS-mf-1892, pp 9-10) UV INTERSTELLAR ABSORPTION LINES IN THE SPECTRUM OF ZETA PUP. Chapter 2. de Boer, K. S.; Pottasch, S. R.; Hoekstra, R., van der Hucht, K. A.; Kamperman, T. M.; Lamers, H. J. (Rijksuniversiteit, Croningen, Netherlands). 20 Dec 1974.

This chapter has been published in Astron. Astrophys., v. 21 (1972) p. 447-448; 9 refs.

In interstellar absorption lines in the ultraviolet. (Rijksuniversiteit Groningen (Netherlands)).

Interstellar absorption lines have been detected in the spectrum of the 05 star ζ Pup. They are due to the resonance lines of Mg II λ 2803, 2796, Mg I λ 2852, Fe II λ 2586 and Mn II λ 2576, and possibly Fe I λ 2522.

30530 (INIS-mf-1892, pp 11-12) ON THE PHOTOIONIZATION RATES IN INTERSTELLAR GAS. Chapter 3. de Boer, K. S.; Pottasch, S. R. 20 Dec 1974.

This chapter has been published in Astron. Astrophys., v. 28 (1973) p. 145-146; 19 refs., 1 fig., 1 table.

In interstellar absorption lines in the ultraviolet. (Rijksuniversiteit Groningen (Netherlands)).

Photoionization rates in the interstellar gas are calculated using OAO-2 data for the interstellar radiation density. A comparison is given with earlier results.

30531 (INIS-mf-1892, pp 13-16) ON THE COMPOSITION OF THE INTERSTELLAR GAS TOWARDS ζ PUP. Chapter 4. de Boer, K. S.; Pottasch, S. R. 20 Dec 1974.

This chapter has been published in Astron. Astrophys., v. 28(1973) p. 155-158; 19 refs., 4 tables, 1 fig.

In interstellar absorption lines in the ultraviolet. (Rijksuniversiteit Groningen (Netherlands)).

UV-interstellar absorption lines measured in the direction of ζ Pup by the S 59 satellite spectrograph are presented. These data are combined with other interstellar line measurements in the same star to derive a curve of growth and element abundances.

30532 (INIS-mf 1892, pp 17-20) OSCILLATOR STRENGTHS FOR IONIZED IRON AND MANGANESE. Chapter 5. de Boer, K. S.; Pottasch, S. R.; Morton, D. C.; York, D. G. 20 Dec 1974.

This chapter has been published in Astron. Astrophys., v. 31(1974) p. 405-408; 12 refs., 2 figs., 4 tables.

In interstellar absorption lines in the ultraviolet. (Rijksuniversiteit Groningen (Netherlands)).

The observed strengths of interstellar absorption lines of Fe II and Mn II in the spectra of α Vir, β Cen, π Sco, and ζ Oph along with laboratory f values of some of these lines between 2343 and 2606 Å have been used to determine curves of growth for these ions and the f values of 10 lines of Fe II and 3 lines of Mn II between 1055 and 1261 Å. The Fe and Mn abundances are derived.

30533 (INIS-mf-1892, pp 21-27) OBSERVATIONS OF THE INTERSTELLAR Na 3302 DOUBLET AND THE INTERSTELLAR SODIUM ABUNDANCE. Chapter 6. de Boer, K. S.; Pottasch, S. R. 20 Dec 1974.

This chapter has been published in Astron. Astrophys., v. 32(1974) p. 1-5; 36 refs., 4 tables.

In interstellar absorption lines in the ultraviolet. (Rijksuniversiteit Groningen (Netherlands)).

Observations are presented of the interstellar neutral sodium UV doublet at 3302 Å (to be called Na U doublet). Together with the scarce U line data in the literature, these form the basis for deriving accurate Na column densities, which are an order of magnitude larger than values derived from the D lines alone. After allowance for ionization balance we find total sodium to hydrogen is close to the solar abundance value. Using both doublets (U and D) we find that the internal doppler velocities are of the order of 1-3 kms^{-1} in most clouds.

30534 (INIS-mf-1892, pp 29-34) MEASUREMENTS OF INTERSTELLAR ABSORPTION LINES BETWEEN 3241 AND 3969 A. Chapter 7. de Boer, K. S.; Pottasch, S. R. 20 Dec 1974.

This chapter will be published in Astron. Astrophys.; 11 refs., 2 tables, 1 fig.

In interstellar absorption lines in the ultraviolet. (Rijksuniversiteit Groningen (Netherlands)).

Profiles for the interstellar CaIIK absorption lines towards a Car, I Sco, X Oph, HD 154090 and γ Arc, as well as some results on interstellar TiII and CN are presented.

30535 (INIS-mf-1892, pp 35-55) INTERSTELLAR CARBON I LINES IN ζ OPHIUCHI. Chapter 8. de Boer, K. S.; Morton, D. C. 20 Dec 1974.

This chapter will be published in Astron. Astrophys.; 26 refs., 2 figs., 4 tables and 1 appendix.

In interstellar absorption lines in the ultraviolet. (Rijksuniversiteit Groningen (Netherlands)).

With the help of two new f-values of CI lines obtained from the spectra of ζ Pup and γ^2 Vel, we show that the interstellar CI spectrum in ζ Oph obeys an optical-depth relation similar to the one observed with NaI. From this, the relative strengths for 19 multiplets are determined. From the literature all processes to excite neutral carbon are collected, and the dominant ones are used to calculate populations of the fine-structure levels as a function of n_H and T. From these data we find evidence that the CI lines are formed in the dense cloud in front of ζ Oph at a heliocentric velocity of -14.4 km s^{-1}. The observed column-density ratios of the C^0 fine-structure levels lead to a total density of H nuclei $n_H = 220$ to 660 cm^{-3} since $N_{H_2} = N_{H_2}$. However, the electron density and observed C^+ abundance imply $n_{H_t} = 10^4$ cm^{-3}, with a gas layer of 0.05 pc thick. At present we cannot decide between these two results.

30536 (INIS-mf-1892, pp 57-82) THE ANALYSING PROCEDURES. Chapter 9. de Boer, K. S. 20 Dec 1974.

33 refs., 5 figs., 3 tables.

In interstellar absorption lines in the ultraviolet. (Rijksuniversiteit Groningen (Netherlands)).

The problems and uncertainties which arise when only the equivalent widths of observed lines are used for an analysis with the curve of growth are discussed. Gross errors have arisen from this method, in older literature where the complexity of interstellar profiles could not yet be appreciated, but also the recent literature contains several erroneous results. The profiles available in o Per and ζ Oph are analysed based on a few simple restrictions as an example. The observed interstellar profiles in the visual range can be reconstructed quite well, and then other interstellar lines and profiles are more easily approached.

30537 (INIS-mf-1892, pp 83-91) INTERSTELLAR DEPLETION, A MYSTERY. Chapter 10. de Boer, K. S. 20 Dec 1974.

27 refs., 1 fig.

In interstellar absorption lines in the ultraviolet. (Rijksuniversiteit Groningen (Netherlands)).

Current theories on interstellar abundances are reviewed, and it is concluded that part of the depletion of metals has to be explained by the lack of reliability of, and by errors in the curve of the growth method used in this analysis. The remaining depletion can be explained without much difficulty by assuming that the depleted metals are in the interstellar dust.

30538 VIBRATIONAL THEORY OF PION CONDENSATION. Nalcioglu, O. (Univ. of Wisconsin, Madison); Goswami, A. Lett. Nuovo Cim.; 15: No. 10, 359-363(6 Mar 1976).

A theory was previously developed for studying the vibrational and the intermediate regions in the study of pion condensation for neutron stars and nuclear matter. The advantage of this method is that one can study particle and vibrational modes simultaneously. It is shown that the application of this method to the Sawyer Hamiltonian enables one to bridge the gap between the previous works on this subject. (JFP)

30539 SPONTANEOUS SYMMETRY BREAKING IN THE INTERIOR OF A NEUTRON STAR. Janson, M. M. (Johns Hopkins Univ., Baltimore). Lett. Nuovo Cim.; 15: No. 7, 231-234(14 Feb 1976).

It was previously argued that spontaneous symmetry breaking in unified theories of weak and electromagnetic interactions may have a cosmological origin. On writing down a conformally invariant gauge theory with a Higgs field, it was shown that the Gursey–Penrose term in the Higgs Lagrangian acts effectively as a mass term with negative mass squared. Once this idea of generating spontaneous symmetry breaking is accepted, it is obvious that it must have other consequences as well. In particular, one expects the gravitational field to influence the effective strength of weak interactions in stellar interiors. Preliminary results for this problem are reported. A prototype gauge theory in a curved space with prescribed metric tensor is used. The calculation serves to strengthen the belief that the approach studied for spontaneous symmetry in curved space is fundamentally sound. (JFP)

30540 TURBULENCE AND PARTICLE ACCELERATION. Scott, J. S. Tucson, AZ; Univ. of Arizona (1975). 62p. University Microfilms Order No. 76-1600.

Thesis (Ph. D.).

A model for the production of high energy particles in the supernova remnant Cas A is considered. The ordered expansion of the fast moving knots produces turbulent cells in the ambient interstellar medium. The turbulent cells act as magnetic scattering centers and charged particles are accelerated to large energies by the second order Fermi mechanism. Model predictions are shown to be consistent with the observed shape and time dependence of the radio spectrum, and with the scale size of magnetic field irregularities. Assuming a galactic supernova rate at $\frac{1}{50}$ yr^{-1}, this mechanism is capable of producing the observed galactic cosmic ray flux and spectrum below 10^{16} eV/nucleon. Several observed features of galactic cosmic rays are shown to be consistent with model predictions. A model for the objects known as radio tail galaxies is also presented. Independent blobs of magnetized plasma emerging from an active radio galaxy into an intracluster medium become turbulent due to Rayleigh-Taylor and Kelvin-Helmholz instabilities. The turbulence produces both in situ betatron and 2nd order Fermi accelerations. Predictions of the dependence of spectral index and flux on distance along the tail match observations well. Fitting provides values of physical parameters in the blobs. The relevance of this method of particle acceleration for the problem of the origin of X-ray emission in clusters of galaxies is discussed. (Diss. Abstr. Int., B)

30541 CHARGED BLACK HOLES IN THE INTERSTELLAR MEDIUM. Suffern, K. G. (Sydney Univ. (Australia). Dept. of Applied Mathematics). Astron. Astrophys.; 39: No. 2, 275-279 (Mar 1975).

It is shown that an ionized interstellar medium at kinetic temperature T K containing an imbedded magnetic field of strength H Gauss will accrete onto a black hole via the independent particle approximation provided the mass of the hole satisfies the inequality $M/M(S) \ll 3.4 \times 10^{-8}(T/10^4\ K)^{\frac{1}{2}}(H/10^{-6}\ Gauss)^{-1}$. If the mass of the black hole satisfies the further inequalities $10^{-14} \leq M/M(S) \ll 7 \times 10^{-11}(T/10^4\ K)^{\frac{1}{2}}n^{-\frac{1}{2}}$ in an ionized hydrogen medium with particle number density n/cm^3, the hole will acquire a net positive electric charge of 2×10^{-24} M statcoulomb in a time of $2.5 \times 10^4(T/10^4\ K)^{\frac{1}{2}}(M/10^{-12}M(S))^{-1}n^{-1}$ seconds. (DE)

30542 PECULIAR A STARS IN GALACTIC CLUSTERS. Hartoog, M. R. Ann Arbor, MI; Univ. of Michigan (1975). 66p. University Microfilms Order No. 75-29,238.

Thesis (Ph. D.).

MK spectral types were determined for 263 B and A stars in the southern galactic clusters NGC 2287, 2422, 2451, 2516, 2547, 3228, and 3532 in order to investigate the frequency of Ap stars in galactic clusters. It was concluded that Ap stars of the Hg–Mn type could not be reliably identified at classification dispersion. Only Ap stars of the Si, Sr, Cr, or Eu types were considered. If one disregards photometric membership criteria for the Ap stars but not the normal stars, then there are 11 Ap stars and 203 normal B5 to A5 stars in these clusters. This frequency is lower than that found in two field samples. When this sample is combined with published data for other clusters, one has a sample which includes 38 Ap stars and 744 normal B5 to A5 stars. A χ^2 test indicates that this frequency is lower than the field frequency at the 98.8% and 96.6% confidence levels for two field samples. Several systematic effects that may have influenced this result are investigated. It is possible that systematic effects may account for the apparent deficiency, so the above result must be regarded as provisional. Only about half of the Ap stars found in the present paper appear to be cluster members from their position in the color-magnitude diagram. Effects are considered which might perturb the colors of Ap stars in such a way as to make them appear as nonmembers in the color-magnitude diagram. Flux redistribution due to the peculiar abundances appears promising. Some Ap stars deviate from the normal stars in the observed color-magnitude diagram but not necessarily in a luminosity vs. effective temperature diagram. If these stars were considered nonmembers, the apparent deficiency of Ap stars in galactic clusters would be more serious than indicated here. (Diss. Abstr. Int., B)

30543 ULTRAVIOLET SPECTRA OF THE WOLF–RAYET STARS HD 50896 AND HD 191765 FROM THE S2/68 SKY-SURVEY TELESCOPE IN TD-1A. Cucchiaro, A.; Jamar, C.; Macau-Hercot, D. (Univ., Liege). pp 657-661 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116–.

The ultraviolet spectra of two bright Wolf-Rayet stars HD 50896 and HD 191765 (in the range of 1350–2550 Å) have been reduced from the S2/S68 spectrophotometer results. All strong emission lines are satisfactorily explained and identified; a rather strong complex emission near 1990 Å remains unidentified. Effective temperatures of their atmospheric envelopes have been estimated from the emission line intensities. A calculation of the abundances with a fairly plausible ionization temperature has been carried out assuming thermal ionization from excited levels. (auth)

30544 MODIFIED REGIONAL AVERAGING METHOD. II. Comparison with the P-3 Approximation. Viik, T. Publ. Tartu. Astrofiz. Obs.; 42: 281-291(1974).

The monochromatic radiative transfer equation is solved for the case of a spherical shell atmosphere in the P-3 approximation using variational boundary conditions and the generalized Riccati transformation. It is shown that the accuracies of the P-3 approximation and the modified regional averaging method are comparable and thus the latter is preferred, because of the smaller number of differential equations to be solved— 5 in the case of the regional averaging method and 8 in the case of the P-3 approximation. The accuracies of the modified regional averaging method are compared with the P-3 approximation of the spherical harmonics method in the case of a spherical shell atmosphere.

30545 PHOTOELECTRIC OBSERVATIONS OF ϵ AURIGAE OUT OF ECLIPSE. Albo, H.; Sorgsepp, L. Publ. Tartu. Astrofiz. Obs.; 42: 166-175(1974). (In Russian)

Three-color photoelectric UBV observations of ϵ Aur during the interval February 14 to May 10, 1968, are presented. A flare of the star has been observed. (auth)

30546 LONG-PERIOD VARIABLE YY CEPHEI. Albo, H. Publ. Tartu. Astrofiz. Obs.; 42: 176-179(1974). (In Russian)

Using the photographic plates of the Tartu Observatory, the light curve of YY Cep is obtained. (auth)

30547 IMPROVEMENT OF SOME PARAMETERS OF JOHNSON PHOTOMETRIC SYSTEM. Sapar, A.; Malyuto, V. Publ. Tartu. Astrofiz. Obs.; 42: 71-93(1974). (In Russian)

Color-indices of the Johnson photometric system UBVRI have been calculated for normal stars of a wide range of spectral and luminosity classes. The averaged spectral energy distributions were taken from the catalogue by Straizys and Sviderskiene. The response curves for UBV found by Azusienis and Straizys and for RI—by Johnson were used. Confrontation of the calculated color-indices (denoted with minuscules) with the observed ones is plotted. A wider range of stellar spectral types and stars of different luminosity classes are used. To remove the scaling difference made evident by the confrontation of the calculated and the observed color-indices V−R and V−I, it has been assumed that the spectral energy distributions in the catalogue correspond to the real ones and the discrepancy is caused as a result of response curves being somewhat in error when compared with the real ones. Constants C for UBVRI have been calculated, assuming that the bolometric correction for V of the Sun is equal to −0.07 and the spectral energy distribution corresponds to that found by Labs and Neckel. The mean wavelength values λ_0 for all the response curves used are given. (auth)

30548 CONSERVED QUANTITIES IN KINEMATIC DYNAMO THEORY. Lerche, I. (Massachusetts Inst. of Tech., Cambridge). J. Math. Phys. (N.Y.); 17: No. 1, 17-23(Jan 1976).

Using a Lagrangian approach to the magnetic induction equation in an infinite medium, it is demonstrated that there exist seven conserved quantities which, by analogy with classical mechanics, labeled as "energy," "momentum," and "angular momentum." For prescribed fluid motions the detailed conservation equations are spelled out. For a fluid motion which is turbulent one also gives the average conserved quantities. In a pragmatic sense it is expected that these conservation laws will be of use in attempts to obtain numerically accurate solutions to the turbulent kinematic dynamo equations. Since the magnetic induction equation is not self-adjoint, numerical attempts to date have to impose some extraneous ad hoc "criteria of goodness" at any given level of numerical truncation. The conserved quantities given provide an internal check of the accuracy of any numerical calculation without the necessity for arbitrarily imposed external criteria of accuracy. As such they should be a powerful tool in rapidly increasing the accuracy of numerical solutions to the kinematic dynamo equations. It is also pointed out that the conserved quantities can be used to indicate the possibility of kinematic dynamo activity ahead of any detailed calculations. (auth)

30549 QUARKS IN ASTROPHYSICS. Pedicek, A. Obz. Mat. Fiz.; 20: No. 2, 55-56(Mar 1973). (In Slovak)

The relation between quarks and the energy source of quasars and their red shift is considered. Specific data are given for the elements H, Ne, Ar, and P. (RWR)

30550 SCHWARZSCHILD BLACK HOLE IN AN ASYMPTOTICALLY UNIFORM MAGNETIC FIELD. Hanni, R. S.; Ruffini, R. (Princeton Univ., NJ). Lett. Nuovo Cim.; 15: No. 6, 189-194 (7 Feb 1976).

The structure of a Schwarzschild black hole's magnetic field is studied from three points of view. First the physical components of the Lorentz force acting on a magnetic monopole of unit strength at rest at a given point in the Schwarzschild background is analyzed locally. Then the lines of force as seen from a far away observer are analyzed to give a complete picture of the field. And lastly, the lines of constant flux are introduced which coincide with the lines of force and allow one to space them so that their density is proportional to the physical components of the Lorentz force. The structure of these lines of force is shown schematically. (JFP)

30551 CARINA ARM STUDIES. II. Photometry of Faint Early-Type Stars in Carina. Wramdemark, S. (Lund Observatory, Sweden). Astron. Astrophys., Suppl. Ser.; 23: No. 2, 231-247(Feb 1976).

Faint early-type stars in the Carina direction (l = 290°) have been detected on three-color plates. Photoelectric photometry has been made in UBV (V < 15) and Hβ(V < 13). From combined UBV and Hβ photometry individual distances have been determined. From UBV data alone minimum distances have been determined. The interstellar extinction is low and amounts to about 3^m at r = 10 kpc. In the same direction as the HII region R54a about ten early-type stars have been found with distances exceeding 10 kpc. This group of stars is proposed to be exciting stars of the nebula instead of MR 32. The velocity residuals of the HII regions in the field determined by Humphreys and Kerr (1974) are discussed. The relation between the most distant stars and the galactic structure is examined. Two fields, one at b = 0° and one just below, were investigated. The stellar density seems to be somewhat higher in the plane than below it. (auth)

30552 PHOTOELECTRIC UBV PHOTOMETRY OF SIX CEPHEIDS. Wachmann, A. A. (Hamburg Observatory). Astron. Astrophys., Suppl. Ser.; 23: No. 2, 249-259(Feb 1976).

Photoelectric UBV photometry of six δ Cep stars is discussed. The observations of IR Cep, V924 Cyg, V1154 Cyg, EU Tau, V526 Mon and GQ Ori are presented as well as their mean V light, (U-B) and (B-V) color curves. (auth)

30553 INTERNAL STRUCTURE OF A POLYTROPE OF CONSTANT GRAVITATIONAL MASS DENSITY IN GENERAL RELATIVITY. Sharma, J. P. Indian J. Phys.; 48: No. 4, 344-352(1974).

For static polytropic fluid spheres of constant gravitational mass density, which are in hydrostatic equilibrium, the field equation of general relativity was obtained in dimensionless forms. The solution of the field equation for n = O (a case representing a homogeneous liquid) was given in explicit forms; for other positive real values of n, for example, n = 0.5, 1, 3 and 5, the solutions do not exist in closed form. Expressions for the mass-radius relation, the total energy, the proper energy density and the gravitational potential energy, which lead to provide some understanding about the internal structure of polytrope (which is idealized as a sphere of uniform density ρ of total mass M and radius R), are given. 18 ref. (auth)

30554 FOUR-COLOR PHOTOMETRY OF ECLIPSING BINARIES. IIIA. ζ Phe, Observations. Clausen, J. V.; Gyldenkerne, K.; Gronbech, B. (Univ. of Copenhagen). Astron. Astrophys., Suppl. Ser.; 23: No. 2, 261-275(Feb 1976).

uvby observations of the double lined eclipsing binary ζ Phe are presented. The observations have been obtained by means of the Strömgren spectrograph photometer for simultaneous measurements in the four colors. This photometer has been attached to the Copenhagen 50 cm reflector mounted at ESO, La Silla in Chile. The analysis of the light curve is presented in a separate paper. (auth)

30555 ORBITAL ELEMENTS OF THE SPECTROSCOPIC BINARY HD 160861 AND DISCUSSION ABOUT THE SYSTEM. Carquillat, J. M.; Pedoussaut, A.; Gineset, N.; Nadal, R. (Observatoires de Pic du Midi et de Toulouse). Astron. Astrophys., Suppl. Ser.; 23: No. 2, 271-281(Feb 1976). (In French)

After obtaining twenty-eight spectra in Haute-Provence Observatory, in addition to four past observations in Mount-Wilson Observatory (1919-21) it is deduced that the spectroscopic binary HD 160861 has a period of 2.50574d. Orbital elements determined from observations are: $V_0 = -15{,}83$ kms^{-1}, k = 44,99 kms^{-1}, $\omega = 33°6$, e = 0,059, T = 2442280,70 JD, a sin i = 1,548 10^6 km, f(m) = 0,0236 $m_\odot$. Two of the Mount-Wilson observations lie above the velocity curve computed from the orbital elements just given. If the period is adjusted to 2,50572d all the Mount-Wilson observations would lie systematically above the velocity curve, perhaps indicating that the V_0 is variable. Approximate calculations suggest that the secondary is a dwarf star of a mass between 0,45 and 0,90 $m_\odot$ and that the separation of the two components is about 10 $r_\odot$. (auth)

30556 CRITICAL STUDY OF THE ADIABATICITY HYPOTHESIS IN THE ARNETT CANONICAL MODEL OF EXPLOSIVE STELLAR NUCLEOSYNTHESIS. Arnould, M.; van Vliet, J. (Univ., Brussels). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 5, 675-685(1975). (In French)

In the canonical model of Arnett, used in the study of explosive

stellar nucleosynthesis, it is assumed, among other things, that there is an adiabatic expansion of the stellar gas. Adopting the other hypotheses of this model, this adiabaticity is replaced by the idea of the first principle of thermodynamics. All energy transfer being neglected during the explosive phenomenon, for which the simple qualitative ideas seem well justified, a criterion is formulated for the validity of the adiabaticity hypothesis, and it is applied essentially to explosions in which the temperature remains below the neighborhood of 10^{9}°K. This would be the case in particular for stellar zones rich in hydrogen and/or helium. It appears that the adiabaticity criterion would be violated for the explosion of certain zones. (tr-auth)

30557 DENSITY FLUCTUATIONS IN AN EXPANDING VISCOUS AND CONDUCTING UNIVERSE. II. Simon, R. (Univ., Liege). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 5, 686-705(1975).

The effect of radiative viscosity and thermal conductivity on density fluctuations in a hot Einstein-de Sitter expanding universe is investigated, in the frame of general relativity, in the radiative period before decoupling, by means of the Thomas expression for the stress-energy tensor. Initial conditions are taken as general and density fluctuations evolve according to a superposition of two acoustic modes and one conductive mode. When irreversible effects become important, in the course of the expansion, the two acoustic modes are exponentially damped, but the conductive mode remains remarkably stationary. Numerical integrations were realized for masses ranging between 10^{20} and 10^{8} solar masses, between $R = 10^{-2}$ ($R = 1$ corresponds to equipartition of energy between matter and radiation) and $R = 18.2$ (decoupling). (auth)

30558 LUMINOSITY OF SPHERICAL PROTOSTARS. Appenzeller, I. (Goettingen Univ. (F. R. Germany). Sternwarte); Tscharnuter, W. (Goettingen Univ. (F. R. Germany). Sternwarte; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Astron. Astrophys.; 40: 397-399(1975).

2 figs.; with refs.

Hydrodynamic model computations have been carried out for a spherically symmetric 1 M(S) protostar. Compared to similar computations by Larson (1969) a different treatment of the accretion shock front was used. Computations basically confirm Larson's results and show that Larson's disputed shock jump conditions have little influence on the protostellar models. (DE)

30559 COLLAPSE OF ROTATING PROTOSTARS. Tscharnuter, W. (Goettingen Univ. (F. R. Germany). Sternwarte). Astron. Astrophys.; 39: No. 2, 207-212(Mar 1975).

4 figs.; 14 refs. Part of the Habil. Schr. 1974.

Numerical calculations have been made for the early stages of the collapse of axisymmetric protostellar clouds including rotation. For rapid rotation the cloud reexpands after initial collapse. This result does not confirm Larson's suggestion that a ring-mode instability should appear. Moreover, in all other model calculations carried out with varying total mass and angular momentum the collapse proceeds with a density distribution that is highly peaked in the center and in a manner which makes the growing of a ring instability even more unlikely. The accretion of mass onto the opaque core is retarded by the centrifugal forces near the equatorial plane and by pressure forces in the neighborhood of the axis of rotation. The numerical results indicate that a hypothetical solar nebula would evolve with a strong central condensation from the very beginning. (DE)

30560 R- AND S-MODES IN A SYNCHRONOUSLY ROTATING COMPONENT OF A BINARY. Denis, J.; Smeyers, P. (Louvain Univ. (Belgium). Astronomisch Inst.). Astron. Astrophys.; 40: 411-414(1975).

3 tabs.; with refs.

The perturbation procedure derived in a previous paper is applied to obtain the frequencies of the R- and S-modes in a synchronously rotating component of a binary. It is found that a tidal action increases the rotational splitting between the frequencies of the R- and S-modes. This effect is more pronounced when the central concentration of the model is low. It does not seem possible to explain the multiple periodicities of some β Canis Majoris stars in terms of R- and S-oscillations in the context of uniform rotation. (DE)

30561 BLACK HOLES AND THERMODYNAMICS. Hawking, S.W. (California Institute of Technology, Pasadena, California 91125). Phys. Rev. D 13: No. 2, 191-197 (15 Jan 1976).

A black hole of given mass, angular momentum, and charge can have a large number of different unobservable internal configurations which reflect the possible different initial configurations of the matter which collapsed to produce the hole. The logarithm of this number can be regarded as the entropy of the black hole and is a measure of the amount of information about the initial state which was lost in the formation of the black hole. If one makes the hypothesis that the entropy is finite, one can deduce that the black holes must emit thermal radiation at some nonzero temperature. Conversely, the recently derived quantum-mechanical result that black holes do emit thermal radiation at temperature $\kappa\hbar/2\pi kc$, where κ is the surface gravity, enables one to prove that the entropy is finite and is equal to $c^3A/4G\hbar$, where A is the surface area of the event horizon or boundary of the black hole. Because black holes have negative specific heat, they cannot be in stable thermal equilibrium except when the additional energy available is less than 1/4 the mass of the black hole. This means that the standard statistical-mechanical canonical ensemble cannot be applied when gravitational interactions are important. Black holes behave in a completely random and time-symmetric way and are indistinguishable, for an external observer, from white holes. The irreversibility that appears in the classical limit is merely a statistical effect. (auth)

30562 PARTICLE EMISSION RATES FROM A BLACK HOLE: MASSLESS PARTICLES FROM AN UNCHARGED, NONROTATING HOLE. Page, D.N. (California Institute of Technology, Pasadena, California 91125). Phys. Rev. D 13: No. 2, 198-206 (15 Jan 1976).

Hawking has predicted that a black hole will emit particles as if it had a temperature proportional to its surface gravity. This paper combines Hawking's quantum formalism with the black-hole perturbation methods of Teukolsky and Press to calculate the emission rate for the known massless particles. Numerical results indicate that a hole of mass $M > 10^{17}$ g should emit a total power output of $2 \times 10^{-4}\hbar c^6 G^{-2} M^{-2}$, of which 81% is in neutrinos, 17% is in photons, and 2% is in gravitons. These rates plus an estimate for the emission rates of massive particles from smaller holes allow one to infer that a primordial black hole will have decayed away within the present age of the universe if and only if its initial mass was $M < (5 \pm 1) \times 10^{14}$ g. (auth)

30563 TIDAL FRICTION IN THE BINARY PULSAR SYSTEM PSR 1913+16. Balbus, S.A.; Brecher, K. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology). Astrophys. J. 203: No. 1, 202-205 (1 Jan 1976).

It is shown that in the binary stars system containing the pulsar PSR 1913+16; orbital-period changes produced by tidal friction may be significant. If the unseen companion is a white dwarf with a turbulent atmosphere, one expects orbital-period changes of order $(P^{-1}dP/dt) \simeq 10^{-9}$ yr^{-1}. This is larger than the predicted period change due to gravitational radiation and other higher-order post-Newtonian effects. Detection of an orbital-period *increase* of this magnitude will almost certainly imply that the unseen companion is a white dwarf. (auth)

30564 DIRECTION OF SUBPULSE DRIFTING WITHIN PULSAR RADIO EMISSION ENVELOPES. Ruderman, M. (Department of Physics, Columbia University). Astrophys. J. 203: No. 1, 206-208 (1 Jan 1976).

It is shown how the direction of drifting subpulses (as well as their subperiods) within pulse envelopes is consistent with observations for certain pulsar models. These have localized electron-positron discharges in polar gaps together with a large angle between the spin axis and the magnetic dipole moment. (auth)

30565 CURRENT FLOW IN PULSAR MAGNETOSPHERES. Cheng, A.; Ruderman, M. (Department of Physics, Columbia University); Sutherland, P. Astrophys. J. 203: No. 1, 209-212 (1 Jan 1976).

When particle flow is mainly outward through the light cylinder of a rotating pulsar magnetosphere, the resulting current flow leads to very large potential drops along field lines wherever $\Omega \cdot B$ vanishes (as suggested by Holloway). These occur no matter what the sign of the charge above the magnetic polar cap. For fast pulsars such a gap potential drop is limited by pair production discharge. In such models current flow into and out of the pulsar cap is always carried by particles of the same sign ($-\Omega \cdot B$) unless the magnetic polar axis is nearly perpendicular to the spin axis. For the Crab pulsar, the gap potential at breakdown is $\sim 10^{14}$ V, and the resulting radiation is mainly hard X-rays and γ-rays up to 10^{11} eV. The latter are expected to be emitted almost perpendicular to the magnetic axis and probably, therefore, should be observed almost 90° earlier in phase than much lower energy pulsar emission. (auth)

30566 CRUST-BREAKING BY NEUTRON SUPERFLUIDS AND THE VELA PULSAR GLITCHES. Ruderman, M. (Department of Physics, Columbia University). Astrophys. J. 203: No. 1, 213-222 (1 Jan 1976).

Anderson's suggestion of neutron superfluid vortex pinning and unpinning in the crust lattice of a neutron star as the origin of pulsar timing noise is combined with existing estimates of the lattice breaking strength and creep. For the Vela pulsar such models give large sudden jumps in frequency and in slowing down rates and an interval between glitches all of which are comparable to those observed. The qualitative differences between Vela and Crab glitches can also be understood. (auth)

30567 STABILITY OF A BEAM-PLASMA SYSTEM AGAINST THE EXCITATION OF THE LONGITUDINAL MODE AROUND

PULSARS. Hinata, S. (Center for Astrophysics). Astrophys. J. 203: No. 1, 223-225 (1 Jan 1976).

The possibility of radio wave emission from the beam-plasma system around pulsars is investigated. The indirect generation of radio waves by first exciting the longitudinal mode is found unlikely, because the beam-plasma system is stable against the excitation of such a mode around the pulsar polar caps. This may be understood if we realize that the rate of excitation of the longitudinal mode is likely to be less than the coherent curvature-radiation loss rate at any level of excitation. (auth)

30568 MAGNETOSPHERIC SHOCK DISCONTINUITIES IN PULSARS. I. ANALYSIS OF THE INERTIAL EFFECTS AT THE LIGHT CYLINDER. Ardavan, H. (Department of Physics, Arya-Mehr University, Tehran, Iran). Astrophys. J. 203: No. 1, 226-232 (1 Jan 1976).

A relativistic version of the generalized Ohm's law is derived, and on the basis of this equation the conditions for the validity of the magnetohydrodynamic approximation $E+(V/c)\times B=0$ in the limit where $\gamma=(1-V^2/c^2)^{-1/2}\gg 1$ are investigated (E and B are the electric and the magnetic fields and V is the streaming velocity of the plasma). It is found that, independently of the relative magnitudes of the inertial and the magnetic forces, this approximation is applicable to the corotating part of the magnetosphere of a pulsar as long as $(c/\omega_p - {}^{\bullet}L)^2 \ll 1$, where $\omega_p - {}^{\bullet}$ is the proper-frame value of the electron plasma frequency and L is the length scale over which the macroscopic properties of the plasma vary appreciably. From this result, the extent of the region of the magnetosphere within which the inertial forces come into effect is estimated, and it is shown that throughout this region—whose thickness is of the order of the mean free path of an electron in the plasma—the gradients of the various plasma variables are significantly large. It is then proposed that a solution of the plasma-electromagnetic field equations consistent with these conditions is one which entails the presence of a steady shock discontinutiy at the light cylinder. (auth)

30569 PULSAR GEOMETRIES. II. DECOMPOSITION OF THE RADIATION PATTERN. Oster, L. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards and Department of Physics and Astrophysics, Boulder); Sieber, W. Astrophys. J. 203: No. 1, 233-244 (1 Jan 1976).

The model proposed in Paper I is extended to describe in detail the observed time structure of pulsar emission. It is shown with computer-generated examples that all data can be fitted to small variations of the model parameters. An attempt is made to separate the effect of geometrical parameters and their variations from the effect of differences in the physical emission mechanism. For one specific example the radiation pattern is derived on the basis of observations. Finally, a preliminary attempt is made to relate our findings to a physical emission mechanism. (auth)

30570 A POSSIBLE OPTICAL IDENTIFICATION FOR PSR 0833-45. Lasker, B.M. (Cerro Tololo Inter-American Observatory, La Serena, Chile). Astrophys. J. 203: No. 1, 193-195 (1 Jan 1976).

Deep photographs show a blue star with magnitude ~23.7 about 1.″8 from the Molonglo position for PSR 0833-45. This star does not pulsate like the Crab optical pulsar, but a change association with a field star is unlikely on the basis of color and star-counts. Most likely the object is physically with the pulsar. (auth)

30571 DETERMINING THE STELLAR MASSES IN THE BINARY SYSTEM CONTAINING THE PULSAR PSR 1913+16: IS THE COMPANION A HELIUM MAIN-SEQUENCE STAR? Roberts, D.H.; Masters, A.R.; Arnett, W.D. (University of Illinois at Urbana-Champaign). Astrophys. J. 203: No. 1, 196-201 (1 Jan 1976).

We determine the stellar masses and the angle of inclination for the system containing PSR 1913+16 in terms of the observable periastron advance and second-order relativistic effects, for the cases (*a*) in which classical contributions to the apsidal motion are negligible, and (*b*) in which the companion is a helium main-sequence star. In case *b*, the apsidal motion constant is calculated from models of such stars. We find that, depending on the values found for the observable parameters, it may be possible to distinguish between cases *a* and *b*. We also comment on the further uncertainty in the mass determination which arises if the companion is a rapidly rotating degenerate dwarf or helium main-sequence star. Black holes, neutrons stars, degenerate dwarfs, and helium main-sequence stars remain viable candidates for the companion at present. (auth)

30572 EFFECTS OF TIDAL DISTORTION ON BINARY-STAR VELOCITY CURVES AND ELLIPSOIDAL VARIATION. Wilson, R.E. (Goddard Institute for Space Studies, New York City); Sofia, S. Astrophys. J. 203: No. 1, 182-186 (1 Jan 1976).

Radial velocity curves for the more massive components of binaries with extreme mass ratios can show a large distortion due to tides, as first recognized by Sterne. Binaries in which the effect is large should be rare because nearly all such binaries would be in the rapid phase of mass transfer. However, the optical counterparts of some X-ray binaries may show the effect, which would then serve as a new means of extracting considerable information from the observations. The essential parts of the computational procedure are given. Light curves for ellipsoidal variables with extreme mass ratios were also computed, and were found to be less sinusoidal than those with normal mass ratios. (auth)

30573 HR 7129: A HELIUM VARIABLE WITH A LARGE MAGNETIC FIELD. Wolff, R.J.; Wolff, S.C. (Institute for Astronomy, University of Hawaii). Astrophys. J. 203: No. 1, 171-176 (1 Jan 1976).

Zeeman spectroscopic observations show that the helium variable HR 7129 has a longitudinal magnetic field that varies between the limits +7000 gauss and −5000 gauss in a period of 3.670 days. The spectrum and radial velocity variations can be accounted for in terms of the oblique dipole rotator model, as can the conspicuous crossover effect that is also observed in this star. Since the temperature of HR 7129 is approximately 20,000 K, this object represents an extension to much higher temperature of the phenomena that are observed in the classical, magnetic Ap stars. (auth)

30574 METAL-RICH GLOBULAR CLUSTERS IN THE GALAXY. III. THE "X-RAY" GLOBULAR CLUSTER NGC 6441. Hesser, J.E. (Cerro Tololo Inter-American Observatory); Hartwick, F.D.A. Astrophys. J. 203: No. 1, 97-112 (1 Jan 1976).

From a photoelectric and photographic investigation in the *UBV* system of the very compact, low galactic latitude, southern globular cluster NGC 6441, we have found characteristics in the C-M diagram that are in accord with observations of the most metal-rich globular clusters in the Galaxy. After an extensive discussion of the problem of isolating the cluster stars from the field stars, and of the problem of determining $E\ (B-V)$, we adopt $E\ (B-V)=0.46\pm0.15$ mag. If $M_{V,HB}=+0.9$ mag, then $(m-M)_0=14.7\pm0.3$ mag. This makes NGC 6441, one of the intrinsically brightest globular clusters in the Galaxy, consistent with the large mass determined recently by Illingworth. However, no unusual features were detected in its C-M diagram that might account for its appearing within the error box of the 3U 1746–37 X-ray source, except possibly the anomalous position of V6 in the diagram. It is also found that NGC 6441 has a normal M/L ratio, and that, if our adopted reddening is correct, it is at perigalacticon. (auth)

30575 METAL-RICH GLOBULAR CLUSTERS IN THE GALAXY. IV. A COLOR-MAGNITUDE DIAGRAM FOR NGC 6304. Hesser, J.E. (Cerro Tololo Inter-American Observatory); Hartwick, F.D.A. Astrophys. J. 203: No. 1, 113-123 (1 Jan 1976).

From a study to $V=19.1$ and $B=20.8$ mag in the *UBV* system of ~385 stars near the G2 globular cluster NGC 6304, we have found a color-magnitude diagram whose characteristics appear similar to those of 47 Tucanae, supporting the conclusion that NGC 6304 is a moderately metal-rich cluster. The reddening, $E\ (B-V)$, has been estimated to be 0.58 ± 0.005 mag, and the distance modulus is found, assuming $M_{V,HB}=+0.9\pm0.2$ mag, to be $(m-M)_0=13.4\pm0.2$ mag. The cluster is thus 4.8 kpc from the Sun and 450 pc above the galactic plane, and it has an absolute visual magnitude of −6.8. Cluster membership of the numerous variable stars in this field remains uncertain, although one red and two possible RR Lyrae variables may be cluster members. (auth)

30576 EFFECTS OF MAIN-SEQUENCE BRIGHTENING ON THE LUMINOSITY EVOLUTION OF ELLIPTICAL GALAXIES. Tinsley, B.M. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California at Santa Cruz). Astrophys. J. 203: No. 1, 63-65 (1 Jan 1976).

The brightening of stars with main-sequence lifetimes longer than the age of the galaxy has significant effects on the evolution of the integrated luminosity of model elliptical galaxies. Analytical and numerical models that treat dwarfs as unevolving may lead to misleading results, possibly even underestimating the rate at which the integrated magnitude becomes fainter. (auth)

30577 STELLAR EVOLUTION. Pt. 3. The Overshooting from Convective Cores. Maeder, A. (Observatoire de Geneve, Sauverny (Switzerland)). Astron. Astrophys.; 40: 303-310(1975).

The problem of the boundary of convective cores is examined. An attempt is made to remove the local character of the equation of energy transport in computations of stellar models and also to avoid the use of Schwarzschild's criterion, which is a local one. Convection in stellar cores is calculated explicitly with non-local expressions of the mixing-length formalism and an iterative process is proposed to integrate simultaneously the equations of stellar structure and the equations describing convective motions. The method is applied to a chemically homogeneous star of 2 M(S); the results show that the zone of overshooting (i.e. the zone between the points where the mean acceleration and the mean velocity of convective motions are each equal to zero) typically extends over 15% of a mixing-length. (DE)

30578 A MODEL OF X PERSEI. Paczynski, B.; Ziolkowski, J. (Polska Akademia Nauk, Warsaw. Zaklad Astronomii). Astron. Astrophys.; 40: 351-354(1975).

A possible model for a close binary system X Persei is dis-

cussed. Evidence is presented that the primary is a post mass loss star of about 5 solar masses, and the secondary is a rapidly rotating star of about 25 solar masses, surrounded by the gaseous disc accreted in the recent phase of mass exchange. It cannot be concluded that the possibility that the 25 solar mass object in the center of the accretion disc is a black hole, but a possible evolutionary pattern leading to such a configuration is unnecessarily complicated. Light variation is predicted with an orbital period of about 584 days and with the luminosity maximum at the phase when the BO primary is in front. The source of weak X-ray emission is not discussed. (DE)

30579 THE FREQUENCY OF CONTACT BINARIES AND ITS CONSEQUENCE ON THEIR EVOLUTION. Veer, F. van't (Centre National de la Recherche Scientifique, 75-Paris (France). Inst. d'Astrophysique). Astron. Astrophys.; 40: No. 1/2, 167-174(Apr 1975). (In French).

The number of contact binaries (CB) limited to a certain apparent magnitude is estimated. In order to find the percentage of CB's among the dwarf stars of different spectral type, the eclipsing binaries are used and this distribution is extrapolated for the whole sample of CB's. The percentage of G dwarfs among CB is discussed. Furthermore, the life-time of CB's is estimated and their evolution to a protoplanetary cloud. (DE)

30580 THE ABUNDANCE DETERMINATION IN A STELLAR ATMOSPHERE. Pt. 1. LTE Experimentation Using An Artificial Non-LTE Spectrum. Dumont, S.; Heidmann, N.; Pecker, J. C. (Centre National de la Recherche Scientifique, 75-Paris (France). Inst. d'Astrophysique); Jefferies, J. T. (Hawaii Univ., Honolulu (USA). Inst. for Astronomy). Astron. Astrophys.; 40: No. 1/2, 127-132(Apr 1975).

It is shown that the classical LTE analysis of an atomic spectrum of a solar-like star leads to values of the abundance A which may be different from the real values. Various uncertainties affect the results derived from neutral lines. However, proper selection of the observational data, for instance use of ion lines, can lead, in similar cases at least, to good values of A. These conclusions concern the solar-like case; however, they emphasize that, in all cases, the effect of departures from LTE needs very careful discussion. (DE)

30581 BREMSSTRAHLUNG RADIATION IN PLASMA IN A QUANTIZING MAGNETIC FIELD. Sazonov, V. N.; Tuganov, V. F. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 2, 165-172(1975). (In Russian).

The bremsstrahlung radiation power in a quantizing magnetic field is calculated in the Born approximation for the nonrelativistic case when the electron energy $\epsilon \ll \hbar\omega_B$ (ω_B is the Larmor frequency). The radiation is shown to have 100% linear polarization. The problem of the possibility of the maser amplification of radiation is investigated. The plasma is regarded as rarefied so that it does not influence on propagation of radiation. (auth)

30582 W 44: A BUOYANT SUPERNOVA REMNANT. Jones, E. M. (Los Alamos Scientific Lab., N. Mex. (USA)). Astron. Astrophys.; 39: No. 1, 143-146(Feb 1975).

If the HI shell observed around supernova remnant W 44 is identified as the fossil blast wave, W 44 is 7 million years old. The apparent 13 pc buoyant displacement of the non-thermal source has been produced by a 0.7 pc $Myr^{-2} = 2.1 \times 10^{-9}$ cm s^{-2} local gravitational field. This acceleration is twice the mean Oort value at the altitude of W 44. The acceleration vector is inclined about 30 degrees from the normal vector to the galactic plane. (DE)

30583 THE ENERGY BALANCE AND MASS LOSS OF STELLAR CORONAE. Hearn, A. G. (Heidelberg Univ. (F.R. Germany). Lehrstuhl fuer Theoretische Astrophysik). Astron. Astrophys.; 40: 355-364(1975).

Calculations of the energy losses of a stellar corona by conduction, radiation and mass loss show that for a given coronal base pressure, there is an average coronal temperature for which the energy loss is a minimum. These minimum flux coronae give a monotonic relation between the base pressure of the corona (and its average temperature) and the flux of energy needed to balance its energy losses. This means that for a given star the main parameters of the corona depend only on the flux of energy heating it. The expressions for the energy loss of a stellar corona are applied to OB Supergiants, Wolf Rayet stars and the solar corona. (DE)

30584 THE SYMBIOTIC BINARY V 1016 CYGNI, EARLY STAGE OF A PLANETARY NEBULA. Mammano, A.; Ciatti, F. (Osservatorio Astrofisico, Asiago (Italy)). Astron. Astrophys.; 39: No. 2, 405-412(Mar 1975).

New spectroscopic observations of the radiostar with infrared excess V 1016 Cyg in the range 3,800-10,900 A have been obtained at Asiago in 1971-1974. During the present quasi-stationary phase in B and V, increasing excitation is shown by the strengthening of He II, [Fe VI] and [Fe VII] lines, which coexist with low-excitation features like OI, [Fe II] and absorption bands of TiO and VO. The physical characteristics indicate that a very hot star excites a nebula which is ejected by a long-period variable. This latter may be responsible for the strong infrared excess. (DE)

30585 WOLF-RAYET STARS AND GALACTIC STRUCTURE. Stenholm, B. (Lund Univ. (Sweden). Institutionen foer Astronomi). Astron. Astrophys.; 39: No. 2, 307-318(Mar 1975).

A 15° wide strip along the galactic equator between longitudes 250 and 360° has been searched for Wolf-Rayet stars. Six new WR stars and four new planetary nebulae have been found. Seven stars earlier listed as WR stars have been rejected as such. The new WR stars in the "Luminous Stars in the Southern Milky Way" are discussed. A sample of 154 WR stars has been treated statistically. For the distribution in longitude, comparisons are made with OB stars and classical cepheids. The differences in distribution are thought to be an age effect. An effort to explain the empty interval towards the anticenter is made. The distribution in latitude is compared with young clusters and long-period cepheids. The physical plane formed by these objects is tilted about one degree to the galactic plane and the tilt is upwards in the Cygnus direction. This result is also received by a least squares solution of the objects when given in rectangular coordinates. The WR star sample is regarded as fairly complete up to a distance of 5 kpc. (DE)

30586 THERMIONIC EMISSION AND PULSAR MAGNETOSPHERES. Lubart, N. D. Tucson, AR; Univ. of Arizona (1975). 134p. University Microfilms Order No. 75-19,585.

Thesis (Ph. D.).

Approximate calculations have shown that a neutron star with a strong surface magnetic field is solid at extremely elevated temperatures. If the surface is solid, then only a few known emission mechanisms exist capable of supplying the necessary charged particles which are subsequently accelerated by the electromagnetic field near the pulsars. The purpose of this work is to refine the calculation of the cohesive energy and melting temperature of the surface of the presence of a strong magnetic field for materials possibly constituting the neutron star surface ranging from helium to iron. The cohesive energy is computed using the cellular approximation. The electron work function is computed using a method developed by Seitz involving the application of Koopmans' Theorem. The ion work function is computed using thermodynamic arguments. A modification to the Richardson-Dushmann Equation is developed for the thermionic emission from solids in the presence of a strong magnetic field. Thermionic emission is shown to be able to supply copious numbers of ions and electrons at least during the early life of pulsars. (Diss. Abstr. Int., B)

30587 PROPERTIES OF CEPHEID VARIABLES IN THE LARGE MAGELLANIC CLOUD. Connolly, L. P. Tucson, AR; Univ. of Arizona (1975). 167p. University Microfilms Order No. 75-26,929.

Thesis (Ph. D.).

B and V magnitudes have been determined for 135 cepheids in the northwest section of the Large Magellanic Cloud (LMC). The magnitudes were derived from plates taken with the Uppsala Schmidt at Mount Stromlo and with the Michigan Curtis Schmidt at the Cerro Tololo Interamerican Observatory. Three photoelectric sequences were used to reduce the magnitudes and to determine the reddening in the vicinity of the cepheids. A uniform reddening of 0.06 was found. Usable light curve parameters are given for 119 cepheids. The cepheids form a homogeneous sample with no variation in their properties detected over the field. The period-luminosity relation for these cepheids has a smaller slope than found by other investigators. The reason for this is the more complete sample of short period cepheids which were found to contain some cepheids bluer and brighter than normal. Low amplitude sinusoidal cepheids are found among these blue cepheids which suggest they may be pulsating in the first harmonic. Using twelve Galactic cepheids with known absolute magnitudes, the period-luminosity relation gives a distance modulus of 18.56 for the LMC. The colors of the cepheids correlated with the residuals from the period-luminosity relation for long periods only. The amplitudes show no such correlation. When long period cepheids observed by another investigator are included it is found that the long period cepheids are restricted to a narrow path in the instability strip which first moves to the blue edge and then to the red edge of the strip. The path may be the result of a narrowing of the instability strip or it may indicate an evolutionary track. Circumstellar dust may cause the path to move toward the red edge of the strip. The crossing of the instability strip by the path is the reason why linear relations, whether with two or three parameters, are not able to satisfactorily fit the long period cepheids. Fitting cepheids to the path may provide an accurate

method of determining distances to long period cepheids. (Diss. Abstr. Int., B)

30588 STUDY OF CARBON STARS WHOSE SPECTRA HAVE SHOWN SiC_2 BANDS. Irvine, C. E. Cleveland; Case Western Reserve Univ. (1975). 95p. University Microfilms Order No. 75-19,215.

Thesis (Ph. D.).

Spectroscopic and photoelectric data have been used to study the N-type carbon stars showing bands of SiC_2. The correlation between the strength of the SiC_2 bands and the violet depression has been confirmed and it was found that $(B-V)_0$ provides a good indication of SiC_2 strength. Both the UBV photometry and a comparison of the strength of the SiC_2 bands with infrared observations supports the hypothesis of Gilra and Code (1971) that the violet opacity is due to SiC. Strong SiC_2 bands are usually associated with large carbon abundance parameters; however, the reverse is not necessarily true. Several stars having variable SiC_2 bands have been found. Evidence is presented showing a possible link between the type of light variation and the strength of the SiC_2 bands. The utility of the SiC_2 bands at lambda lambda 5192-8 in identifying strong SiC_2 stars is discussed. (Diss. Abstr. Int., B)

30589 MATTER IN SUPERSTRONG MAGNETIC FIELDS. Chen, H. H. New York; Columbia Univ., NY (1973). 134p. University Microfilms Order No. 75-18,365.

Thesis (Ph. D.).

In a magnetic field of order 10^{12} gauss, characteristic of neutron star models for pulsars, the atomic, molecular and crystalline forms of matter are radically different than those encountered in the laboratory. Because of the very strong tendency of electrons to move along magnetic field lines, atoms will have greatly increased binding energies and cylindrical, rather than spherical, shapes. Molecules take the form of linear chains of atoms with the chains parallel to the magnetic field lines. A strong chain-chain interaction arises from the large atomic quadrupole moments; an approximately body-centered, cubic crystal lattice is formed from parallel chains. The physical properties of these atoms, molecules, and crystals are investigated in this thesis. It is found that an iron lattice will be bound by about 10 keV per atom and have a density about 10^4 gm/cc. This kind of crystal may exist on neutron star surfaces and therefore may have a significant influence on the pulsar magnetospheric structure. (Diss. Abstr. Int., B)

30590 EXPLANATION OF THE SUPER-METAL-RICH PHENOMENON IN FIELD K GIANTS AS AN EFFECT OF ATMOSPHERIC STRUCTURE. Peterson, R. C. Boston; Harvard Univ. (1974). 99p. University Microfilms Order No. 75-18,083.

Thesis (Ph. D.).

This work examines the super-metal-rich (SMR) phenomenon in K giants. Three field K giants (one SMR) of the same R-I color and spectral type have been observed at high resolution (2 A/mm) in the yellow. A direct determination of their relative metal abundances is made using the ratios of the strengths of weak lines. This shows that every element for which lines less than 300 mA are present has the same abundance in all three stars. The average metal abundance of the SMR star is within 5 percent of the average abundances of the standards. There is a noticeable dependence on excitation potential of the ratios of the strengths of particular lines, namely those of the neutral species of elements with low ionization potential. After considering how the weak lines are formed, it is concluded that a temperature drop exists in the SMR star relative to the normal stars, in the region just above where the continuum is formed. Empirical model atmospheres are constructed for the SMR star and one standard. All measurable lines with strengths less than 300 mA are used to compute abundances for the elements represented. These turn out to be solar to within a few percent for both stars. Calculations are made for the profiles of the Mg b and Na D lines in each star. The Mg b profiles of both stars and the Na D profile of the standard agree with the calculations, but the Na D profile of the SMR star is observed to be much broader in the wings than the computed profile. Comparison of observations of weak CN line strengths with calculations shows that there is an enhancement of the cyanogen abundance in the SMR star. Calculations assuming a factor of two enhancement in the nitrogen abundance match the observed equivalent widths. Discussions of line formation indicate which lines are affected by cooling at a particular spectral type. The observed behavior with spectral type of the line features used to identify SMR stars is consistent with the explanation of the SMR phenomenon in K giants as a consequence of cooling. The effect of cooling on certain standard luminosity criteria is mentioned, with special attention paid to the determination of the luminosity of the stars contributing to the infrared light of M31 and M81. (Diss. Abstr. Int., B)

30591 HIGH RESOLUTION RADIO OBSERVATIONS OF SUPERNOVA REMNANTS. Becker, R. H. College Park, MD; Univ. of Maryland (1975). 169p. University Microfilms Order No. 75-28,731.

Thesis (Ph. D.).

The radio observations made at 3.7 and 11.1 centimeter wavelengths of four supernova remnants (G11.2 – 0.4, G21.5 – 0.9, G29.7 – 0.3, and 3C391), an HII region (G45.5 +0.1), and a radio galaxy (3C386) are presented and discussed. The supernova remnant G21.5 – 0.9 has an elliptical brightness distribution and is similar to the Crab Nebula and 3C58 in appearance. The two remnants G29.7 – 0.3 and 3C391 both show a broken shell structure typical of most galactic supernova remnants. The observations of the radio galaxy 3C386 reveal an extended double source and an unresolved source at the nucleus with a steep nonthermal spectrum. An analysis of galactic supernova remnants shows that there is a relationship between spectral index and z-distribution. Remnants with flat spectra are found at greater distances from the galactic plane on the average than are the remnants with steep spectra. The difference in z-distances is attributed to a population difference between flat- and steep-spectrum remnants. (Diss. Abstr. Int., B)

30592 KINKS AND EXTENSIONS. McCollum, G. New York; Yeshiva Univ. (1975). 48p. University Microfilms Order No. 75-20,585.

Thesis (Ph. D.).

Kinks, homotopically nontrivial lightcone fields on R^4, can be black holes without curvature singularities, satisfying the weak energy condition. Kinks and all other spherically symmetric stationary spacetimes on R^4 with roots of g_{00} have incomplete geodesics which need extension. For simple roots the Kruskal extension method works and the topology around each root is that of the Kruskal manifold. For multiple roots another extension method is given, based on symmetry, and another topology. (Diss. Abstr. Int., B)

30593 INTERSTELLAR MOLECULES—A REVIEW. Bhonsle, R. V. (Physical Research Lab., Ahmedabad (India)). pp 61-68 of Proceedings of the Seminar on Infrared and Millimeter Range Astronomy, Hyderabad, February 25-26, 1974. Alladia, S. M.; Abhyankar, K. D. (eds.). Hyderabad; Osmania University (1974).

From seminar on infrared and millimeter range astronomy; Hyderabad, India (25 Feb 1974). 3 figs., 1 table listing molecules discovered in clouds.

The present state of knowledge of interstellar molecules identified by means of radio spectral line measurements from 1.8 mms. to 36 cms. is reviewed. The existence of twenty-three organic and inorganic molecules in a total of thirty-four isotopic combinations, which has already been verified by researchers, is explained. It is shown that interstellar molecules range from simple diatomics to complex organic compounds comprising as many as seven atoms. The importance of radio spectral line observations to such basic problems as formation of stars, structure of the galaxy, physics of molecular clouds etc., is briefly discussed. (KB)

30594 SEARCH FOR OPTICAL IDENTIFICATIONS IN THE 5C3-RADIO SURVEY. Pt. 2. Statistical Treatment and Results. Richter, G. A. (Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Astrophysik). Astron. Nachr.; 296: No. 2, 65-81(1975).

On plates of the large Schmidt-telescope of Karl-Schwarzschild observatory Tautenburg, taken by BORNGEN, 139 radio sources of the 5C3 area were inspected for possible identifications with optical subjects. The results are published in the appendix. A detailed analysis of these objects showed a relatively large number of about 65 real identifications up to the utmost plate limit $B \approx 21^m.7$, which corresponds to an identification rate of about 47%. The individual reliability of each possible optical identification is estimated. Apparently the identified objects are galaxies, "blue" and "neutral" quasars, and one H II-region of the Andromeda nebulae. It is of great cosmological interest that no "red" quasars could be found. (GC)

30595 THE THEORY OF RELATIVISTIC STELLAR WINDS AND ITS APPLICATIONS TO PULSARS. Rayburn, D. R. Kingston, Ont.; Queen's Univ. (1971). 172p. INIS.

Thesis.

We have derived the equations of magnetohydrodynamics in a manifestly covariant way in both the Minkowski and Schwarzschild metrics. We have applied these equations to the problem of an axisymmetric steady stellar wind and have discussed the applicability of this model to the pulsar problem. We have also considered the corotating zone of an oblique rotator pulsar model. (auth)

30596 THEORY OF A CONDENSED CHARGED-BOSE, CHARGED-FERMI GAS. Dahl, D. A. (Stanford Univ., CA). Ann. Phys. (N.Y.); 95: No. 1, 10-34(Nov 1975).

Field-theoretic methods are used to derive the low-temperature properties of a dense, neutral gas of condensed charged (+Ze) bosons (mass M) and degenerate charged (-e) fermions (mass m). The density–density correlation function exhibits two collective modes for m much less than M: a plasmon branch and a phonon branch with speed c equals V/sub F/(Zm/3M)/sup ½/. Boson single-particle excitations are gapless and coincide with the phonon mode at low k. Inclusion of the two interacting dynamical components leads to small shifts in the boson and fermion ground-state energy and boson depletion relative to the values obtained for models with rigid, inert, neutralizing backgrounds. (auth)

30597 MODEL OF A TYPE I SUPERNOVA NEAR MAXIMUM LIGHT. Mustel', E.R.; Chugai, N.N. (Astronomical Council, USSR Academy of Sciences, Moscow). Sov. Astron.—AJ 19: No. 4, 411-415 (July 1975).

Some photometric and spectrophotometric data for type I supernovae are analyzed. The color and spectrophotometric temperatures T_c and T are compared for *SN* 1972*e*; prior to and at maximum light (epoch t_m), $T_c \simeq T$, but shortly after maximum light $T_c < T$. The substantial departure of T_c from T is attributed to the major role of wide metal absorption lines in attenuating the short-wave part ($\lambda \lesssim 5000$ Å) of type I supernova spectra when $T \lesssim 10{,}000°$K. The behavior of the photospheric radius R_p of type I supernovae is investigated from the most acceptable time dependence of T (appreciable error is introduced if T_c is used). At maximum light R_p tends to increase linearly with time at a rate of $\simeq$5000 km/sec, reaching its greatest value 30–35^d after t_m; afterward R_p decreases fairly rapidly. The photospheric expansion velocity is about half the mean expansion velocity of the ejected supernova envelope. An extrapolation of the $R_p(t)$ relation to $R_p \simeq 0$ for *SN* 1972*e* and 1970*j* yields epochs of -25^d and -16^d (relative to maximum *V* brightness), respectively, for the onset of the explosion and expansion. The contribution of the temperature dependence of the opacity to the behavior of a type I supernova photosphere is discussed. An analysis is made of the bolometric luminosity of type I supernovae at maximum light. Computations show that the bolometric maximum is reached well before the visual maximum. (auth)

30598 QUANTITATIVE ANALYSIS OF THE SPECTRUM OF BETA LYRAE IV. LINE IDENTIFICATIONS FOR THE FAINT COMPONENT AND THE MASS OF BOTH STARS. Skul'skii, M.Y. (L'vov University Observatory). Sov. Astron.—AJ 19: No. 4, 434-439 (July 1975).

High-dispersion spectrograms exhibit broad, shallow lines in the composite spectrum of β Lyr that probably belong to the faint component. The radial-velocity curve derived from these lines has a semiamplitude of $\simeq$48 km/sec. The components of the close binary have a mass ratio $\alpha = 0.26$; the mass of the bright *B*9 star is $3.8\,\mathfrak{M}_\odot$ while the faint component has a mass of $14.6\,\mathfrak{M}_\odot$. (auth)

30599 THE TIP OF THE RED GIANT BRANCH (A COMPARISON OF THEORY AND OBSERVATION). Kadla, Z.I. (Main Astronomical Observatory, Academy of Sciences of the USSR). Sov. Astron.—AJ 19: No. 4, 492-494 (July 1975).

Observational data on the five brightest giants in the globular clusters *M*3, *M*5, *M*13, *M*15, and *M*92 are compared with theoretically computed data on the helium flash. The theoretical models considered agree with the observations: with increasing metal abundance $T_{eff}(fl)$ decreases, i.e., the values $(B\text{-}V)_0(5)$, the mean $(B\text{-}V)_0$ value for the five brightest giants of a cluster (Fig. 3), increase. It is shown that a comparison of the observed mean absolute magnitudes of the five brightest giants of the different clusters, $M_V(5)$, with the computed $M_{bol}(fl)$ can provide data on bolometric corrections. It is also pointed out that a more complete array of models with computed evolutionary tracks for giants and additional observational data on the masses of giants of different clusters are necessary for a more detailed comparison of theory and observations. (auth)

30600 THE DIFFRACTION IMAGE OF A DOUBLE STAR IN THE PRESENCE OF CENTRAL BLOCKING IN THE OBJECTIVE. Mikhel'son, N.N. (Principal Astronomical Observatory, Academy of Sciences of the USSR). Sov. Astron.—AJ 19: No. 4, 505-508 (July 1975).

The intensity distribution in the diffraction image of a point for different degrees of central blocking ϵ, the radii of the dark (m_1, m_2, and m_3) and bright (M_2 and M_3) rings, the relative intensity in the first three bright rings, the frequency-contrast responses, the profiles of the diffraction images of a double star for a brightness difference Δm of the components from $0^m.0$ to $2^m.0$, and the dependences of the contrast on the distance between the components are calculated. It is shown that the contrast of a double star images increases with increase of central blocking. The dependence of the distance q between components on their brightness difference for a $K=0$ and 1.5% is determined. Maksutov's well-known result is confirmed. (auth)

30601 EVIDENCE OF THE EXISTENCE OF AN EXTENDED OPTICAL FORMATION AROUND A NEUTRON STAR IN THE X -RAY BINARY SYSTEM HZ Her(Her *X*-1). Cherepashchuk, A.M. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 19: No. 4, 537-538 (July 1975).

There seems to be an extended optical accreting formation with a radius of ~ 3–4 $R_\odot$ and an optical luminosity of $\leqslant 10^{35}$ erg/sec around a neutron star in the HZ-Her system at all phases of the 35-day cycle. (auth)

30602 ORION-2: FIRST SCIENTIFIC RESULTS. Gurzadian, G. A. Vestn. Akad. Nauk SSSR; 13-24(Jan 1975). (In Russian).

Preliminary results of observations of the UV spectra of weak stars (9th to 12th magnitude) in the 2000 to 5000 A range made from the Orion-2 observatory on board Soyuz-13. About 10,000 spectrograms of more than 3000 stars were obtained over 5 days with a meniscus telescope and objective prism. Data are presented for a group of about 20 previously uncataloged stars detected around Capella, in Auriga; more than 20 Type B stars in Vela; emission stars with spectral lines assigned to such metals as iron, chromium, nickel, cobalt, and others; interstellar absorption at 3000 to 2000 A in the spectrum of SAO 040183, probably due to blocking of emission lines excited in the stellar gaseous envelope; the doublet of 2800 Mg II in stellar spectra; the chromospheres of cold stars; and the UV spectrogram of the planetary nebula NGC II 2149. The possibility of classifying stars according to their continuous spectra is discussed. (IAA)

30603 URCA PROCESS AND THE EVOLUTION OF CARBON STELLAR CORE. Paczynski, B. (Polska Akademia Nauk, Warsaw. Zaklad Astronomii). Acta Astron.; 23: 1-21(1973).

The influence of URCA neutrino cooling on the evolution of degenerate carbon-oxygen cores is studied. When the density is higher than 10^9 g/cm^3 cooling due to the URCA neutrinos is stronger than cooling due to the universal Fermi interactions. For the cosmic abundance of odd mass number nuclei and the core carbon content $X_{12} = 0.5$ the ignition of carbon takes place when the central density of $\log \rho = 9.64$ is reached. Increase of the abundance of odd mass number nuclei and decrease of the carbon content leads to increase of the density at which carbon is ignited. In the appendix to this paper formulas are derived for the rate of URCA energy losses in a vibrating star with a temperature equal to zero, in a static star with a low temperature, and in a contracting degenerate stellar core. (auth)

30604 ON THE EXISTENCE OF LOCAL QUASARS. Rozyczka, M. (Warsaw Univ. (Poland). Obserwatorium Astronomiczne). Acta Astron.; 23: 233-245(1973).

A systematic approach to the problem of position coincidences of quasars and bright galaxies is developed. In order to eliminate subjective factors from the definitions of considered samples, the sample sizes are set by magnitudes and radio fluxes of pair components. The galaxies and quasars are not completely catalogued for any of the considered samples and therefore the sample size has to be estimated. For such samples there can exist still other close pairs which have not yet been discovered. Hence, this paper deals with the upper limits for probabilities of chance coincidences. The derived upper limits are still relatively small. The smallest value of the upper limit of probability, namely $p = 0.001$, is obtained for 3C 232-NGC 3067, and $p = 0.002$ for Markarian 205-NGC 4319. The influence of interstellar absorption is shown to be of no importance. The observed coincidences can be explained in three ways: either there exist some local quasars, or we observe very improbable configurations of objects which are due to chance, or the observed flux of quasar radiation is amplified in the vicinity of some galaxies. The quasars reported on different grounds as local were compared. It is shown that there is not even one quasar listed as local in all three works which were compared (Arp 1967, Burbidge et al. 1971 and Rowan-Robinson 1972). (auth)

30605 NEUTRON AND COLLAPSING STARS. Zeldovich, J. Veda Tech. SSSR; 2: No. 6, 43-49(Dec 1974). (In Czech).

Main characteristics of two sources of x radiation, Hercules X-1 and Cygnus X-1, are presented. The role of gravitational forces in the conversion of stars to neutron or collapsing stars is discussed. (ZS)

30606 SPECTRA OF NOVA SCUTI 1975. Fehrenbach, C.; Andrillat, Y. (Observatoire de Haute Provence, 04 - Saint-Michel-l'Observatoire (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 11, 169-172(15 Sep 1975). (In French).

Some twenty spectra have been obtained up to 1.13μ. Some elements corresponding to low ionization potentials have been identified. Many bright emission lines in infrared were found. These spectra are, to our knowledge, the first obtained in this spectral range with a dispersion of 213A.mm^{-1}. (FR)

30607 CLOUD COLLAPSE AND STAR FORMATION. Jura, M. (Department of Astronomy, University of California, Los Angeles, California 90024). Astron. J. 81: No. 3, 178-181 (Mar 1976).

Using a model for cloud heating, we calculate minimum masses for interstellar clouds to collapse as a function of external pressure, and we find a strong dependence of this critical mass M_{cr}, upon the external pressure. In our model, M_{cr} is approximately independent of metal abundance, but metal-enhanced star formation (MESF) may still occur if clouds are preferentially formed out of metal-rich material. (auth)

30608 NEW OBSERVATIONS OF PULSED X—RAY EMISSION FROM NP 0532. Kestenbaum, H.L.; Ku, W.; Novick, R.; Wolff, R.S. (Columbia Astrophysics Laboratory, Columbia University). Astrophys. J. Lett. 203: No. 2, L57-L61 (15 Jan 1976).

Large-area proportional counters sensitive from 0.6 to 23 keV were used to observe about 3 min of pulsed X-ray emission from NP 0532 during two lunar occultation experiments. A detailed pulse profile with 65 μs resolution shows that the X-ray primary pulse shape is essentially identical to its optical counterpart. Spectral data on the pulsed X-ray emission are presented. A pulse-by-pulse examination of the data shows no evidence for temporal variability. (auth)

30609 NEW RESULTS FROM LONG-TERM OBSERVATIONS OF CYGNUS X-1. Holt, S.S.; Boldt, E.A.; Serlemitsos, P.J. (Laboratory for High Energy Astrophysics, Goddard Space Flight Center); Kaluzienski, L.J. Astrophys. J. Lett. 203: No. 2, L63-L66 (15 Jan 1976).

Observations of Cyg X-1 between 1974 October and 1975 July reveal a persistent $5^d.6$ modulation of the 3–6 keV X-ray intensity, having a minimum in phase with superior conjunction of the HDE 226868 binary system. The modulation is found to be most pronounced just prior to the 1975 April–May increase of Cyg X-1, after which both the modulation and intensity are at their lowest values for the entire duration of the observations. These data imply that the X-ray emission from Cyg X-1 arises from the compact member of HDE 226868, and that the increase of 1975 April–May may have represented the depletion of accreting material which had not yet been mixed into a cylindrically symmetric accretion disk about the compact member. (auth)

30610 THE 4.8 HOUR VARIATION OF CYGNUS X-3 AT HIGH X—RAY ENERGIES. Pietsch, W.; Kendziorra, E.; Staubert, R.; Trümper, J. (Astronomisches Institut der Universität Tübingen). Astrophys. J. Lett. 203: No. 2, L67-L69 (15 Jan 1976).

During a balloon observation of Cygnus X-3 on 1975 February 20, an intensity variation has been found which is in phase with the low-energy X-ray 4.8 hour sinusoidal light curve. The measured relative amplitude in the energy range 32–64 keV is 0.37 (+0.31, −0.29). Compared with the results at lower energies there is no indication for an energy dependence of the relative amplitude up to 64 keV. The encountered low-intensity source spectrum is compared with previous measurements. (auth)

30611 DISCOVERY OF A NONSOLAR EXTREME-ULTRAVIOLET SOURCE. Lampton, M.; Margon, B.; Paresce, F.; Stern, R.; Bowyer, S. (Space Sciences Laboratory, University of California, Berkeley). Astrophys. J. Lett. 203: No. 2, L71-L74 (15 Jan 1976).

We report the first observation of extreme-ultraviolet radiation from an extrasolar object. The data were obtained with a grazing-incidence telescope flown as part of the *Apollo-Soyuz* mission. The source is located in Coma Berenices, at $\alpha_{1950} = 13^h13^m$, $\delta_{1950} = +29°$. Positive detections have been made in the 170–620 A, 114–150 A, and 55–150 A wavelength bands. The intensity is 4×10^{-0} ergs cm^{-2} s^{-1} in the 170–620 A band. Possible identification with the hot white dwarf HZ 43 is discussed. (auth)

30612 CARBON STARS IN THE LARGE MAGELLANIC CLOUD. Crabtree, D.R.; Richer, H.B. (Department of Geophysics and Astronomy, University of British Columbia); Westerlund, B.E. Astrophys. J. Lett. 203: No. 2, L81-L85 (15 Jan 1976).

The properties of seven carbon stars which are very likely members of the Large Magellanic Cloud are discussed. Three exhibit enhanced molecular bands of ^{13}C while one bears a spectroscopic resemblance to the peculiar Galactic carbon star WZ Cas. The range in bolometric absolute magnitude for the seven stars is found to be from −5.7 to −6.6. By placing the stars in a theoretical H-R diagram, it is concluded that (1) all seven are double-shell burning stars, (2) four of the seven have just recently begun helium shell flashes and, (3) the mass range for the objects observed is from 3 to 9 $M_\odot$. (auth)

30613 EVIDENCE FOR MASS LOSS AT MODERATE TO HIGH VELOCITY IN Be STARS. Snow, T.P. Jr. (Princeton University Observatory); Marlborough, J.M. Astrophys. J. Lett. 203: No. 2, L87-L90 (15 Jan 1976).

Ultraviolet spectra of intermediate resolution have been obtained with *Copernicus* of 12 objects classified as Be or shell stars, and 19 additional early B dwarfs. Some of these spectra show marked asymmetries in certain resonance lines, especially the Si IV doublet at 1400 Å, indicating the presence in some cases of outflowing material with maximum velocities of nearly 1000 km s^{-1}. Direct evidence for mass loss at these velocities is seen for the first time in dwarf stars as late as B1.5; the only objects later than B0.5 which show this effect are Be or shell stars. Among the stars considered there is a correlation between the presence of mass-loss effects and projected rotational velocity, suggesting that the ultraviolet flux from B1-B2 dwarfs is sufficient to drive high-velocity stellar winds only if rotation effects reduce the effective gravity near the equator. The mass loss rate for one of the most active Be stars, 59 Cyg, is crudely estimated to be 10^{-10}–10^{-9} $M_\odot$ yr^{-1}. The data are suggestive that the extended atmospheres associated with Be star phenomena may be formed by mass ejection. (auth)

30614 TEMPERATURE DEPENDENCE OF MID-INFRARED SILICATE ABSORPTION. Day, K.L. (Lunar and Planetary Laboratory, University of Arizona). Astrophys. J. Lett. 203: No. 2, L99-L101 (15 Jan 1976).

It has been found that two silicates commonly believed to occur in interstellar space and in circumstellar shells show up to a 65 percent enhancement of the 20 μ region absorption coefficient upon cooling to 80 K. The apparent sharpness of the absorption spectra is also greatly increased. (auth)

30615 APPLICATIONS OF METRIC PERTURBATIONS OF A ROTATING BLACK HOLE: DISTORTION OF THE EVENT HORIZON. Chrzanowski, P.L. (Center for Relativity Theory, The University of Texas, Austin, Texas 78712). Phys. Rev. D 13: No. 4, 806-818 (15 Feb 1976).

The influence of matter perturbations on the horizon of a rotating black hole is studied. The perturbation at the horizon is completely characterized by appropriately defined horizon multipole moments (HMM's which are related to the number flux of quanta across the horizon. These HMM's are evaluated for several cases of interest. Specifically, it is shown that for an extreme Kerr black hole ($a = M$) a ring of matter on the marginally stable circular orbit has no tidal influence on the black hole. On the other hand, a single test particle on the same orbit does raise a tide on the horizon although it does not radiate gravitational waves. Finally, the spin-down law for a black hole in the presence of a distant stationary non-axially symmetric moon is derived. (auth)

30616 THEORY OF THE POLARIZATION OF PULSAR RADIO RADIATION. Cocke, W.J.; Pacholczyk, A.G. (Steward Observatory, The University of Arizona). Astrophys. J. Lett. 204: No. 1, L13-L15 (15 Feb 1976).

The theory of quasi-transverse propagation of radio radiation in pulsar magnetospheres leads to a model in which the intrinsic pulsar emission is linearly polarized, and circular polarization is produced as an effect of the quasi-transverse propagation. Various other observed features of the polarization are likewise explained. (auth)

30617 THE COMPLEX OUTER SHELL OF ETA CARINAE. Walborn, N.R. (Cerro Tololo Inter-American Observatory). Astrophys. J. Lett. 204: No. 1, L17-L19 (15 Feb 1976).

Short-exposure, interference-filter photographs obtained at the prime focus of the CTIO 4 meter reflector reveal the great complexity and extent of η Carinae's outer shell. Some features have increased their distances from the central object with respect to Thackeray's photographs of a quarter-century ago, and some apparent structural relationships are found between features of the homunculus and the outer shell. A speculative relationship to van den Bergh's quasi—stationary flocculi in Cas A is pointed out. (auth)

30618 SLOW MASS TRANSFER IN SEMIDETACHED BINARIES. Pratt, J.P. (Steward Observatory, University of Arizona); Strittmatter, P.A. Astrophys. J. Lett. 204: No. 1, L29-L33 (15 Feb 1976).

It is shown that, if the usual assumption of synchronous rotation (infinitely effective tidal coupling) in semidetached binary systems is replaced by that of detailed conservation of angular momentum with negligible tidal torques, the system is predicted to evolve in a qualitatively different manner after the onset of mass loss. For a wide range of mass ratios, initial mass transfer proceeds on a nuclear rather than a Kelvin time scale and the evolutionary track in the H-R diagram is significantly altered. It is suggested that the actual evolution of the system is determined by the time scale of tidal interaction and that the mass transfer rate probably lies between the classical values and those found here. Possible implications of the present results for X-ray sources such as HZ Her are discussed briefly. (auth)

30619 THE EARLY INFRARED DEVELOPMENT OF NOVA CYGNI 1975. Gallagher, J.S.; Ney, E.P. (School of Physics and Astronomy, University of Minnesota). Astrophys. J. Lett. 204: No. 1, L35-L39 (15 Feb 1976).

Broad-band infrared photometry of Nova Cygni is presented for 50 days following discovery. During the first three days, the energy distribution is approximately that of a blackbody. A distance of 1.5±0.5 kpc is derived from a measurement of the blackbody-expansion parallax. After the fourth day, the energy spectrum is close to F_ν=constant. A possible mechanism for producing this rapid change is discussed.

Although the nova is unusual in several respects, the physical parameters derived from the observations are about normal for a very fast galactic nova. (auth)

30620 MASS LOSS IN RED GIANTS AND SUPERGIANTS. Sanner, F. (Yerkes Observatory, University of Chicago). Astrophys. J. Lett. 204: No. 1, L41-L45 (15 Feb 1976).

The circumstellar envelopes surrounding 13 late-type giants and supergiants have been studied using a homogeneous collection of high-resolution, photoelectric scans of strong optical resonance lines. Various properties of the envelopes, including the mass loss rate, dilution factor, hydrogen density, and degree of ionization, have been determined quantitatively. (auth)

30621 THE LINEAR POLARIZATION OF BY DRACONIS. Koch, R.H. (Department of Astronomy, University of Pennsylvania, Philadelphia); Pfeiffer, R.J. Astrophys. J. Lett. 204: No. 1, L47-L49 (15 Feb 1976).

We report linear polarization measurements in four bandpasses for the flare star BY Dra. The red polarization is intrinsically variable at a confidence level greater than 99 percent. On a time scale of many months, the variability is not phase-locked to either a rotational or a Keplerian ephemeris. The observations of the three other bandpasses are useful principally to indicate a polarization spectrum rising toward shorter wavelengths. (auth)

30622 ZEEMAN OBSERVATIONS OF THE Hα REGION IN BY DRACONIS. Anderson, C.M.; Hartmann, L.W. (Washburn Observatory, University of Wisconsin); Bopp, B.W. Astrophys. J. Lett. 204: No. 1, L51-L54 (15 Feb 1976).

The results of high-dispersion spectrographic observations of the Hα region in the spotted flare star BY Draconis are presented. A "Zeeman" spectrogram obtained with the starspot near the limb shows obvious differences between the Hα emission profile seen in the different senses of circular polarization. If this is interpreted as longitudinal Zeeman effect, a field of 40 kilogauss is implied. The photospheric absorption-line spectrum shows no gross evidence of large magnetic fields, but the sensitivity of these is such that fields of several kilogauss cannot be ruled out. (auth)

30623 AN EXPLANATION OF THE SUPER-METAL-RICH PHENOMENON IN FIELD K GIANTS AS AN EFFECT OF A DIFFERENCE IN SURFACE TEMPERATURE. Peterson, R. (Center for Astrophysics, Cambridge, Massachusetts). Astrophys. J. Suppl. Ser. 30: No. 1, 61-83 (Jan 1976).

We examine the super-metal-rich (SMR) phenomenon in K giants. Three K2 III stars, κ Oph and ι Dra (both relatively normal) and μ Leo (SMR) were observed at high resolution in the yellow and red. The stars, which were chosen on the basis of their red-infrared color, are shown to have the same excitation temperature and surface gravity, thus allowing a direct determination of element abundances to be made by a comparison of the strengths of spectral lines. The result of such a comparison, which is independent of computational uncertainties, is that the abundances of all elements with weak, unblended atomic lines are the same to a few percent in all three stars. Direct comparison of weak lines also demonstrates that a temperature difference exists in the surface layers but not at continuum depths. The SMR star is cooler near the surface than are the others. We show that the effects on spectral indices of such atmospheric cooling in K giants provide a reasonable explanation of the SMR phenomenon. We speculate that an increase in line absorption by CN is the cause of the cooling, and thus of the SMR phenomenon, in K giants. A determination of the carbon and nitrogen abundances is made using CN and C_2 lines. Weak CN lines are stronger in the SMR star, but weak C_2 lines are the same strength. Calculations with model atmospheres constructed empirically show that a normal carbon abundance and a factor of 2 increase in the nitrogen abundance of the SMR star match these observations. Calculations of the abundances of all elements with weak, unblended atomic lines yield solar values to a few percent in each case. The implications of this work on estimates of metal abundances in external galaxies is briefly discussed. The effect of cooling on luminosity criteria is also mentioned, with special attention paid to the determination of the mass-to-light ratio of M31 and M81. (auth)

30624 UV CETI STARS: STATISTICAL ANALYSIS OF OBSERVATIONAL DATA. Lacy, C.H.; Moffett, T.J.; Evans, D.S. (Department of Astronomy, University of Texas at Austin, and McDonald Observatory). Astrophys. J. Suppl. Ser. 30: No. 1, 85-96 (Jan 1976).

A statistical analysis of 386 flares of eight UV Ceti flare stars observed by Moffett indicates (1) no apparent correlation between times of flare occurrence; (2) no apparent correlation between flare energy and the time interval since the preceding flare; (3) flare energies in the *B* and *V* filters and *C* (no filter) are directly proportional to the flare energy in the *U*—band; concurrent observations in other filters can thus be converted to *U*, yielding 770 independent observations of flare energy; (4) the quiescent luminosity in the *U*—band is strongly correlated with the mean flare energy, mean rate of energy loss due to flaring, and spectral index. Cumulative distributions of flare energy with frequency of occurrence are constructed, from which the mean rate of energy loss due to flaring is calculated, with the effects of event detection thresholds being taken into account. Several of the cumulative distributions differ from previous determinations, indicating the possibility of time-dependent distribution parameters. (auth)

30625 CARBON STAR PHOTOMETRY: CO AND 3.2 MICRON BANDS. Faÿ, T.D. Jr. (The University of Alabama); Ridgway, S.T. Astrophys. J. 203: No. 3, 600-602 (1 Feb 1976).

This paper reports filter photometry of CO band strengths at 2.36 μ (filter width=0.18 μ) for 23 carbon stars. Present results are compared with CO depression of 10 stars observed in 1970 at 2.29 μ with a spectral scanner (spectral resolution=0.0032 μ). Our CO index and the scanner index are linearly related, with a standard deviation of 0.04 mag. Each of the 23 carbon stars was also observed at the 3.2 μ band (filter width=0.4 μ). The depression of this unidentified band increases with Na D line strength and C_2 absorption. The 3.2 μ band lacks rotational line structure, and it occurs at the CH stretch frequency common to all hydrocarbon molecules. Our results suggest a possible association between the 3.2 μ band and the C_2H radical. (auth)

30626 APPLICATIONS OF FOURIER ANALYSIS TO BROADENING OF STELLAR LINE PROFILES. II. A SATURATED LINE IN 32 AQUARII AND IN SIRIUS. Smith, M.A. (Department of Astronomy, University of Texas at Austin, and McDonald Observatory). Astrophys. J. 203: No. 3, 603-609 (1 Feb 1976).

An application of Gray's Fourier analysis technique demonstrates that the shape of the Fe I λ4476 profile in 32 Aqr is consistent with a Gaussian microturbulent velocity field in the atmosphere of the Am star. Its magnitude lies in the range 3 ± 1 km s^{-1}. The principal source of error in estimating this parameter is caused by the desaturation of the line when the microturbulence is of this size. The rotational velocity of 32 Aqr is 10 ± 1 km s^{-1}. The amount of Gaussian macroturbulence appears to be negligible (<2 km s^{-1}). The results of this study vitiate our estimate of the line broadening in this star made in an earlier analysis. This study points to one optimistic conclusion concerning curve-of-growth studies. For restricted cases it still appears safe to consider the *differences* in the microturbulent parameter between stars to be physically meaningful. An extremely well observed profile of a saturated line in Sirius is used to derive a rotational velocity of $V \sin i = 17 \pm 1$ km s^{-1}. The roundedness of this observed profile suggests, in addition to the rotation, the presence of a small amount of turbulence, probably macroturbulence. (auth)

30627 INTERPRETATION OF THE SPECTRAL AND PHOTOMETRIC VARIATIONS OF R CORONAE BOREALIS. Hartmann, L. (Washburn Observatory, University of Wisconsin-Madison); Apruzese, J.P. Astrophys. J. 203: No. 3, 610-615 (1 Feb 1976).

A consistent picture explaining both the spectral and photometric (infrared and visual) variations of R Coronae Borealis is developed. It is found that the extreme infrared maximum and minimum can be fitted by dispersion of the same mass of graphite dust. Random clumps of this dust crossing the line of sight both obscure the visual continuum of the object and reveal an emission spectrum from a circumstellar gas cloud, which satisfactorily accounts for the correlation of the emission with episodes of a faint visual continuum. (auth)

30628 THE THREE RADIAL MODES AND EVOLUTIONARY STATE OF AC ANDROMEDAE. Fitch, W.S. (Steward Observatory, University of Arizona); Szeidl, B. Astrophys. J. 203: No. 3, 616-624 (1 Feb 1976).

Analysis of 4662 yellow magnitude measures, obtained at the Konkoly Observatory on 78 nights in 1958–1962, shows that AC And has its fundamental and first and second overtone radial pulsation modes (periods $P_0 = 0^d.71124243$, $P_1 = 0^d.52512677$, and $P_2 = 0^d.421069$) all excited and nonlinearly coupled. Fitting formulae, derived from published pulsation calculations for high-metal-content models ($Z = 0.044$), are given for the direct calculation of mass and radius from observed radial mode period pairs. The multimode excitation of 25 Cepheid-strip stars (comprising eight Cepheids, one RR Lyrae star, nine RRs stars, and seven δ Scuti stars) is discussed. AC And is found to have a mass $M \simeq 3.1\ M_\odot$ and to be a high-mass analog of the δ Scuti stars, in the hydrogen-shell-burning and helium-core-contraction stage of evolution. Pulsation theory, evolution theory, and observation seem to be in excellent agreement for AC And and δ Sct. (auth)

30629 HIGH-DISPERSION OBSERVATIONS OF EMISSION LINES IN THE POSTNOVA HR DELPHINI. Gallagher, J.S. (School of Physics and Astronomy, University of Minnesota); Anderson, C.M. Astrophys. J. 203: No. 3, 625-635 (1 Feb 1976).

The Wisconsin echelle spectrograph has been used on the KPNO 4 m Mayall telescope to obtain high-resolution line profiles of Hα; [N II] λ6548, λ6583; and [O III] λ5007 in the postnova HR Del. The lines show considerable structure with individual subcomponents having velocity widths of 40–70 km s^{-1}, even though the general velocity flow

from the nova is ~500 km s^{-1}. We are able to identify major line components as having been present in the early nebular stage (6 years before the present observations); thus it appears that novae can produce well-defined condensations, even though matter is initially ejected at very high velocities. All lines also contain two major velocity groupings which we designate as shells A (centered near $V = \pm 100$ km s^{-1}) and B ($V = \pm 400$ km s^{-1}). Physical conditions differ in the two shells with shell B being more highly ionized and probably having a higher electron temperature. In shell A we observe I ([N II] λ6584)/ I (Hα) ≃ 2. Possible mechanisms which could produce this ratio including an overabundance of nitrogen are reviewed, and we conclude that the present data are weakly suggestive of a nitrogen excess. The observations are briefly discussed in terms of predictions of theoretical models for novae, and some possible parallels are noted between novae and other objects containing dynamically moving gas. (auth)

30630 SOLUTION OF THE COMOVING-FRAME EQUATION OF TRANSFER IN SPHERICALLY SYMMETRIC FLOWS. II. PICKET-FENCE MODELS. Mihalas, D. (High Altitude Observatory, National Center for Atmospheric Research); Kunasz, P.B.; Hummer, D.G. Astrophys. J. 203: No. 3, 647-659 (1 Feb 1976).

To examine the effect of the radial flow of atmospheric material on the temperature distribution in a stellar atmosphere, a picket-fence model with Gaussian lines is formulated and solved numerically in the comoving frame of the gas, which is assumed to move with a prescribed velocity law. Extensive results have been obtained for both static and dynamical models, with planar and moderately extended spherical geometries. For static models, the effect of lines on the temperature distribution is virtually independent of extension. When a large-scale velocity field is imposed, significant surface heating and additional back-warming are found; the magnitude of these effects increases with the extension of the atmosphere. If a significant flow velocity persists to sufficient depth, the enhanced escape probability can lead to a cooling in the deeper layers, which competes with the back-warming. The results obtained here suggest that the deposition of energy arising from the intrusion of line opacity into the continuum, caused by velocity gradients, could influence the dynamics of the flow. (auth)

30631 FLUORINE POWER AND HELIUM-SHELL FLASHES. Scalo, J.M.; Despain, K.H. (California Institute of Technology). Astrophys. J. 203: No. 3, 667-673 (1 Feb 1976).

During high-temperature helium burning in convective regions the ^{18}F created from $^{14}N(\alpha,\gamma)^{18}F$ may be destroyed by the $^{18}F(\alpha,p)^{21}Ne$ reaction rather than $^{18}F(\beta^+\nu)^{18}O$. The conditions for such burning are met in advanced helium-shell flashes. The resulting nucleosynthesis is examined using a simple one-zone model. It is found that the energy generation rate is significantly enhanced, and that the specific entropy of the convective zone is increased by about 1 m_H/k at $T_9 = 0.45$, $\rho = 10^3$ g cm^{-3}. The possibility that the corresponding extension of the convective zone might be sufficient to cause contact between the carbon-rich and hydrogen-rich layers is examined. (auth)

30632 SYNCHRONIZATION IN BINARIES AND AGE. Levato, H. (Kitt Peak National Observatory). Astrophys. J. 203: No. 3, 680-688 (1 Feb 1976).

Analyzing the published data on field binary systems, we found that the periods below which the orbital and rotational motions are synchronized are systematically longer for evolved main-sequence stars than for ones near the zero-age main sequence. This is interpreted as showing that part of the tendency for tidal interaction to achieve synchronization occurs during the main-sequence lifetime of stars; the remainder occurred during contraction to the zero-age main sequence. (auth)

30633 OPTICAL OBSERVATIONS OF WRA 977. Bord, D.J.; Mook, D.E. (Department of Physics and Astronomy, Dartmouth College); Petro, L.; Hiltner, W.A. Astrophys. J. 203: No. 3, 689-693 (1 Feb 1976).

UBV photometry of WRA 977 on 36 nights between January and July 1974 reveals activity on a time scale of days at the 0.1 mag level; no activity greater than ~0.01 mag is observed on a time scale of minutes. Correlogram and periodogram analyses of the light curve reveal no persistent periodic variations of significant amplitude. (auth)

30634 ON THE DETECTABILITY OF GRAVITATIONAL WAVES FROM W URSAE MAJORIS BINARY STARS. Burke, W.L. (Lick Observatory, Boards of Studies in Astronomy and Astrophysics and in Physics, University of California, Santa Cruz). Astrophys. J. 203: No. 3, 694-696 (1 Feb 1976).

The possibility of using the collective gravitational radiation from all of the W Ursae Majoris binary stars in the Galaxy is considered, and such radiation is shown to be undetectable because of the interference from local gravity gradients. (auth)

30635 ON THE MAXIMUM GRAVITATIONAL REDSHIFT OF WHITE DWARFS. Shapiro, S.L. (Center for Radiophysics and Space Research, Cornell University); Teukolsky, S.A. Astrophys. J. 203: No. 3, 697-700 (1 Feb 1976).

The stability of uniformly rotating, cold white dwarfs is examined in the framework of the Parametrized Post-Newtonian (PPN) formalism of Will and Nordtvedt. The maximum central density and gravitational redshift of a white dwarf are determined as functions of five of the nine PPN parameters (γ, β, ζ_2, ζ_3, and ζ_4), the total angular momentum J, and the composition of the star. General relativity predicts that the maximum redshift is 571 km s^{-1} for nonrotating carbon and helium dwarfs, but is lower for stars composed of heavier nuclei. Uniform rotation can increase the maximum redshift to 647 km s^{-1} for carbon stars (the neutronization limit) and to 893 km s^{-1} for helium stars (the uniform rotation limit). The redshift distribution of a large sample of white dwarfs may help determine the composition of their cores. (auth)

30636 INTERACTION OF NEUTRON STARS WITH BLACK HOLES. Misra, R.M. (Institut für Theoretische Physik der Universität Hamburg, Hamburg, West Germany). Astrophys. J. 203: No. 3, 704-713 (1 Feb 1976).

An object like a neutron star, whose crust and possibly whose core have a lattice structure, and which is in close orbit around a black hole, gets deformed and/or fractures/breaks up due to tidal interaction with the black hole. To analyze this, we discuss here the elastic deformations of such orbiting components—deformations which are small but seem to have been observed in the glitch and noise structures. The equation of geodesic deviation for an infinitesimal, incompressible, homogeneous self-gravitating object in a circular equatorial orbit around a black hole in a slightly generalized form is considered. The elastic structure is specified via the linear theory of elasticity, and Navier's phenomenological criterion of fracture is assumed. It is found that the mode of fracture of the orbiting body in stable circular orbits around a Schwarzschild black hole is similar qualitatively to that for a Kerr black hole. In the case of vanishing modulus of rigidity the earlier results for fluid bodies are recovered. (auth)

30637 SPHERICAL WINDS AND ACCRETION IN GENERAL RELATIVITY. Blumenthal, G.R.; Mathews, W.G. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz). Astrophys. J. 203: No. 3, 714-719 (1 Feb 1976).

Analytic general solutions are obtained for time-independent, adiabatic, spherically symmetric wind and accretion flows in Schwarzschild coordinates. Various equations of state applicable for both relativistic and nonrelativistic temperatures are considered. The general solution is shown to strongly resemble the nonrelativistic stellar wind solution. Finally, shock transitions in special relativity are briefly considered, and it is shown how they can be fitted onto the full solution to accommodate a broader class of boundary conditions. (auth)

30638 LOWER CHROMOSPHERES AND UPPER PHOTOSPHERES OF LATE-TYPE STARS. Ayres, T. R. Boulder, CO; Univ. of Colorado (1975). 208p. University Microfilms Order No. 76-3882.

Thesis (Ph. D.).

High dispersion, well calibrated profiles of Ca II K, Mg II h and k, and H epsilon in five late-type stars, including the Sun are interpreted by constructing plane-parallel, hydrostatic atmospheric models and synthesizing spectra using a "partial redistribution" formalism. In the empirical data there is a strong correlation between the widths of the "K_1" inner wing minimum features and luminosity, analogous to the Wilson-Bappu effect obeyed by the Ca II and Mg II emission half-widths. The lower chromospheric temperature models inferred from the stellar profile data are all surprisingly similar, despite the wide range of k and K emission contrasts observed. A comparison of the inferred upper photosphere and lower chromosphere model for the Sun with the semi-empirical HSRA and Vernazza et al., (VAL) temperature distributions shows a significant disagreement concerning the solar temperature minimum region, although the chromospheric models appear to be much more consistent. From a detailed partial redistribution synthesis of the Ca II K and Mg II h and k emission cores and damping wings, the following is concluded: The "K_2" widths are sensitive to micro-velocity. The emission index is controlled by the lower chromosphere temperature rise. The intensity and wave-length positions of the K_1 features are sensitive to the location of the stellar T/sub min/ in temperature and mass column density. The K_1 width is sensitive to stellar surface gravity to the extent that the continuum optical depth T/sub min/ is independent of g. The extensive damping wings of strong resonance lines can be used to infer upper photosphere structure if the damping parameters and stellar abundances are well determined. In addition, a "complete redistribution" analysis of the stellar H epsilon feature indicates that: H epsilon is a Balmer radiation field "thermometer" in hot, high gravity late-type stars. H epsilon is a chromospheric surface pressure "barometer" in cool, low gravity stars. Finally, the extensive spectrum synthesis undertaken in this investigation supports the results of previous work stressing the importance of properly treating the scattering process in resonance line formation problems. Numeri-

cal methods, including an LTE partial coherent scattering approximation for the line wings and a "partial redistribution"formalism for the line cores, are developed which substantially reduce the computational difficulties of applying the "PRD" approach to stellar line formation problems. (Diss. Abstr. Int., B)

30639 SPECTROPHOTOMETRY OF CARBON STARS. Gow, C. E. Bloomington, IN; Indiana Univ. (1975). 314p. University Microfilms Order No. 76-2821.

Thesis (Ph. D.).

Observations of over one hundred carbon stars have been made with the Indiana rapid spectral scanner in the red and, when possible, in the visual and blue regions of the spectrum. Five distinct subtypes of carbon stars (Barium, CH, R, N, and hydrogen deficient) are represented in the list of observed stars, although the emphasis was placed on the N stars when the observations were made. The rapid scanner was operated in the continuous sweep mode with the exit slit set at twenty angstroms, however, seeing fluctuations and guiding errors smear the spectrum to an effective resolution of approximately thirty angstroms. Nightly observations of Hayes standard stars allowed corrections for atmospheric extinction and instrumental response to be applied to the data to yield absolute spectrophotometry at thirty angstroms resolution. The reduction scheme rests on two assumptions, that thin clouds are gray absorbers and the wavelength dependence of the sky transparency does not change during the course of the night. The validity of the first assumption has been demonstrated and the data collected on nights when the second assumption failed have been discarded. Several stars have been observed in the blue region of the spectrum with the Indiana SIT vidicon spectrometer at two angstroms resolution. From the scanner data, it is possible to derive a color temperature for the yellow-red spectral region by fitting a black-body curve through two chosen continuum points. Photometric indices were calculated relative to the blackbody curve to measure the C_2 Swan band strength, the shape of the CN red (6,1) band to provide a measure of the $^{12}C/^{13}C$ isotope ratio, and in the hot carbon stars (Barium, CH, and R stars) the strength of an unidentified feature centered at 400 angstroms. As an aid in interpreting the observations of the hot carbon stars, an extensive abundance grid of model atmospheres was calculated using a modified version of the computer code ATLAS. Opacity sources included the hydrogenic opacity sources, a modified version of the Mutschlecner and Keller line blanketing scheme, and molecular opacity (as straight mean opacities over 100 inverse centimeter intervals) due to CO, CN (red and violet systems), and C_2 Swan system. (Diss. Abstr. Int., B)

30640 LIGHT OF THE SUPERNOVAE. Morrison, P. (Massachusetts Inst. of Tech., Cambridge). Technol. Rev.; 77: No. 6, 21-28(May 1975).

A fluorescent theory of supernova light is proposed. The initial release of energy following the supernova explosion is presumed to be in the form of ultraviolet radiation. The radiation excites the expanding gaseous shell which fluoresces, emitting visible radiation. Geometrical calculations reveal that a supernova spectrum is the result of light emitted from the surface of an ellipsoid. The supernova of 1972 is used to test the theory. (BJG)

30641 V SIN i VALUES IN THE FAR ULTRAVIOLET. Hutchings, J. B. (Dominion Astrophysical Observatory, Victoria, B. C.). Publ. Astron. Soc. Pac.; 88: No. 521, 5-7(Feb 1976).

A simple treatment of gravity and limb darkening shows that measured V sin i values for OB stars are significantly lower for rapid rotators in the far ultraviolet than in the photographic region of the spectrum. This circumstance should help in determining V, i, omega/omega/sub crit/, and gravity darkening for these stars. (auth)

30642 APSIDAL MOTION IN UX URSAE MAJORIS. Africano, J.; Wilson, J. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 88: No. 521, 8-9(Feb 1976).

Photoelectrically determined times of eclipse minima are given for the eclipsing binary UX UMa. Apsidal motion is discussed as the the cause for the (O–C) residuals. (auth)

30643 H alpha AND H beta PHOTOELECTRIC PHOTOMETRY OF gamma CASSIOPEIAE. Baliunas, S. L.; Guinan, E. F. (Villanova Univ., PA). Publ. Astron. Soc. Pac.; 88: No. 521, 10-12(Feb 1976).

Photoelectric observations of gamma Cas (B0 IVe) were made using two pairs of wide- and narrow-band interference filters centered near the rest wavelengths of the hydrogen Balmer alpha and beta lines. H alpha and H beta indices were obtained on 19 nights from February 1972 to February 1975. Variations in the H alpha and H beta indices were found with a range of 0.18m and 0.10m, respectively. (auth)

30644 HR 5702: A DOUBLE-LINED SPECTROSCOPIC BINARY WITH AN Am PRIMARY COMPONENT. Batten, A. H.; McCall, M. L. (Dominion Astrophysical Observatory, Victoria, B. C.). Publ. Astron. Soc. Pac.; 88: No. 521, 13-18(Feb 1976).

Double lines have been detected in the spectrum of HR 5702, previously known as a single-spectrum binary. The primary component is an Am star and measures of the metal lines in its spectrum lead to the following values for the orbital elements: P equals 3.57725 days, T equals JD2441347.95, omega_1 equals 39.3^0, e equals 0.093, K_1 equals 59.4 km s^{-1}, V_0 equals –22.2 km s^{-1}. Measures of the hydrogen lines in the secondary spectrum give K_2 equals 74.6 km s^{-1} and hence alpha_1 sin i equals 2.91 x 10^6 km, alpha_2 sin i equals 3.65 x 10^6 km, M_2/M_1 equals 0.80, $M_1 \sin^3$ i equals 0.49 M/sub solar mass/, and $M_2 \sin^3$ i equals 0.39 M/sub solar mass/. The measures of the secondary spectrum, however, are much less certain than those of the primary. The relative luminosities of the two stars at a wavelength approximately equal to the effective wavelength of the B magnitude scale are in the ratio of at least 0.49, as deduced from the hydrogen lines, but a mean ratio of between 0.30 and 0.40 was deduced from the metal lines. These figures and the observed (B–V) color index of the system can be understood if the primary star is an Am star with a hydrogen-line type of A7 and the secondary has a normal spectral type of F1. Both stars lie on or near the main sequence. (auth)

30645 MAGNETIC FIELD AND PERIOD OF THE Ap STAR 45 LEONIS. Bonsack, W. K. (Univ. of Hawaii, Honolulu). Publ. Astron. Soc. Pac.; 88: No. 521, 19-21(Feb 1976).

The magnetic field of 45 Leo has been measured in 16 Mauna Kea spectrograms, yielding a range from –230 to +400 gauss, in agreement with Babcock's (1958) results. The magnetic field does not appear to vary systematically with the period of 1.4d found photometrically by Winzer (1974) and Wolff and Morrison (1975). A period near 7.9d is found to represent both the magnetic-field data and the photometry of Wolff and Morrison, but not that of Winzer. It is pointed out that the longer period permits a rigid rotator model for 45 Leo with much less extreme conditions than the shorter period. It is suggested that more photometry is needed to settle the question of the period. (auth)

30646 THREE-COLOR PHOTOELECTRIC INVESTIGATION OF THE ECLIPSING BINARY SYSTEM RZ CASSIOPEIAE. Chambliss, C. R. (Kutztown State Coll., PA). Publ. Astron. Soc. Pac.; 88: No. 521, 22-36(Feb 1976).

The semidetached eclipsing binary system RZ Cas was observed at Kutztown State College Observatory and at Kitt Peak National Observatory on 25 nights from January 1973 to January 1975. Approximately 600 observations each were obtained in yellow, blue, and ultraviolet. RZ Cas has long been known to have a variable period, and a new ephemeris based on the author's observations is given. RZ Cas consists of an A 2V primary component paired with a subgiant component of spectral type about G5 IV. Solutions for its orbital elements were carried out using three different procedures; the Russell-Merrill method, the Kopal-Jurkevich iterative method, and the Wood triaxial ellipsoid model. For the first two procedures, rectified observations were used. The orbital elements obtained with these methods are in excellent agreement with each other but the temperature of the subgiant component derived from an analysis of the yellow light curve is about 500^0K lower than that obtained from the ultraviolet light curve. The Wood model produces orbital elements which differ significantly from those of the spherical model in some cases. A higher temperature is indicated for the subgiant component, but as before, a difference of about 500^0K is indicated between the yellow and ultraviolet light curves with the temperature derived from the blue light curve falling between them. Using the available spectroscopic data for RZ Cas, the masses of the components are estimated as 1.75 M/sub solar mass/ and 0.61 M/sub solar mass/ and their respective radii as 1.45 R/sub solar mass/ and 1.83 R/sub solar mass/. Both the mass and radius of the A2 V component are less than one would expect for a star of this type. RZ Cas is compared with the eclipsing binary V505 Sgr, a system whose primary is also an A 2V star, but of more normal size and mass. The visual absolute magnitude of RZ Cas is estimated as +2.0 and its distances as 70 parsecs. (auth)

30647 RAPIDLY VARYING EMISSION SPECTRUM OF HD 158503. Cowley, A. P. (Dominion Astrophysical Observatory, Victoria, B. C.); Houk, N. Publ. Astron. Soc. Pac.; 88: No. 521, 37-40(Feb 1976).

Spectrograms of the Be star HD 158503 taken during four consecutive nights show that the emission in the hydrogen lines and the Fe II lines varies in intensity and velocity, while the unusual Ca II emission remains constant. It is suggested that this system may be a short-period, interacting binary with the primary below the main sequence. (auth)

30648 HD 196673: A BINARY SYSTEM CONTAINING A BARIUM STAR. Culver, R. B. (Colorado State Univ., Fort Collins); Ianna, P. A. Publ. Astron. Soc. Pac.; 88: No. 521, 41-43(Feb 1976).

Photometric and spectroscopic observations are presented of both members of the binary star system HD 196673 (ADS 14078), whose primary component is a barium star of spectral class K0-Ba(2). The absolute visual magnitude for the barium star primary is found to be –0.7 and the distance to the system is 0.35 kpc. The mass of the barium star is found to lie in the interval 1.5 M/sub solar mass/ less than M/sub Ba/ less than 3 M/sub solar mass/. (auth)

30649 OPTICAL SPECTRA OF SUPERNOVA REMNANTS. Danziger, I. J.; Dennefeld, M. (European Southern Observatory, Santiago de Chile). Publ. Astron. Soc. Pac.; 88: No. 521, 44-49 (Feb 1976).

Montages of red and blue image-tube spectra are presented for 21 different supernova remnants located in the southern Milky Way and in the Magellanic Clouds. Particular spectral characteristics are described for each remnant and some new emission lines are tentatively identified. Attention is drawn to the apparently radio-quiet objects N70 and N185 in the LMC, and a case is made for their being supernova remnants. (auth)

30650 POSSIBLY OVERLUMINOUS TRIPLE STAR, 13 CETI. Gatewood, G. (Univ. of Pittsburgh); Sofia, S. Publ. Astron. Soc. Pac.; 88: No. 521, 50-51(Feb 1976).

Values derived for the masses, luminosities, and colors of the principal components of the 13 Cet system are inconsistent with accepted theory. Further observation of the system is suggested. (auth)

30651 HD 170200: THE SPECTROGRAPHIC ORBIT AND EVIDENCE FOR MASS LOSS. Hube, D. P. (Univ. of Alberta, Edmonton). Publ. Astron. Soc. Pac.; 88: No. 521, 58-62(Feb 1976).

Spectrograms obtained between 1924 and 1975 have been used to derive orbital elements for HD 170200. No completely convincing evidence has been found for any change in these elements during the past 51 years, although the most recent velocities appear to lie systematically below the average velocity curve. On several plates sharp, weak absorption lines are found in the violet wings of the primary-star lines. These cannot be identified with the secondary star and are interpreted as evidence for discontinuous mass loss from the primary. (auth)

30652 FOUR-COLOR AND H beta PHOTOMETRY OF THE GALACTIC CLUSTER NGC 6633. Schmidt, E. G. (Univ. of Nebraska, Lincoln). Publ. Astron. Soc. Pac.; 88: No. 521, 63-66(Feb 1976).

Photometric measurements of stars in the intermediate-age galactic cluster NGC 6633 are presented. From these data the color excess is found to vary slightly across the cluster with an average of E/sub b-y/ equals 0.124m. The distance modulus is found to be 7.71m and the turnoff occurs at about $(b-y)_0$ equals 0.1m. The cluster is slightly metal poor. (auth)

30653 SPECTRUM OF FG SAGITTAE IN 1975. Smolinski, J. (Univ. of Victoria, B. C.); Climenhaga, J. L.; Kipper, T. Publ. Astron. Soc. Pac.; 88: No. 521, 67-68(Feb 1976).

The spectrum of FG Sge in 1975 is compared with spectra of Ia and Ib supergiants of class F5 to G5. The cooling trend described by Langer, Kraft, and Anderson as taking place up to 1972 has continued, but possibly at a faster rate since 1972. The enhancement of rare-earth abundances also is confirmed. Molecular bands are not observed. (auth)

30654 DIGITAL ANALYSIS OF SPECKLE PHOTOGRAPHS: THE ANGULAR DIAMETER OF ARCTURUS. Worden, S. P. (Air Force Cambridge Research Labs., Sunspot, N. Mex.). Publ. Astron. Soc. Pac.; 88: No. 521, 69-72(Feb 1976).

Digital reduction of speckle interferometry data for the K2 III giant alpha Boo (Arcturus) has been done. Angular diameters of 0.019" +- 0.006" were obtained at 4200 A for a uniformly illuminated disk, and 0.027" +- 0.010" for a highly limb-darkened disk. Arcturus is underresolved using the Kitt Peak National Observatory 4-meter telescope. The digital-reduction scheme described here proved ideal for studying such underresolved objects. A discussion of limitations of this technique is also provided. (auth)

30655 OFFSET GUIDER FOR THE PRIME FOCUS OF THE 3.9-METER ANGLO-AUSTRALIAN TELESCOPE. Kobler, H.; Wallace, P. T. Publ. Astron. Soc. Pac.; 88: No. 521, 80-85 (Feb 1976).

The automatic offset guider at the prime focus of the AAT is described. A description of the guider and its organization in the telescope's computerized drive system is followed by the initial results obtained with it. (auth)

30656 ORBIT OF 71 DRACONIS. Willmarth, D. W. (Univ. of Toledo). Publ. Astron. Soc. Pac.; 88: No. 521, 86-87(Feb 1976).

The star 71 Dra is found to be a single-line spectroscopic binary with a period of 5.29807 days and a velocity amplitude of 53.8 km sec^{-1}. (auth)

30657 SEARCH FOR THE POINT HIGH-ENERGY GAMMA RAY SOURCES CARRIED OUT IN THE CRIMEAN ASTROPHYSICAL OBSERVATORY IN THE YEARS 1969–1973. Stepanyan, A. A.; Vladimirskii, B. M.; Neshpor, Yu. I.; Fomin, V. P. Izv. Krym. Astrofiz. Obs.; 53: 29-58(1975). (In Russian).

The data obtained by means of ground based atmospheric Cerenkov light detectors of the Crimean Astrophysical Observatory in the years 1969–73 have been analysed. The basic criterion for selection of data is the atmospheric transparency derived from the observational data itself. The analysis shows there are no meteorological variations in the selected data. The effects of the equipment instability were not revealed for these data. The results of observations of 43 objects of different types are presented. The comparison with published data have been made. It is shown some objects may be considered as gamma-ray sources NP 0532, Cyg X-3, Cas γ-1. Some of them are pulsars, others are sources of gamma-ray with energy 10^8 ev. Some of the radio-galaxies and quasars may be also considered gamma-ray sources but statistical significance is marginal. 57 references (auth)

30658 VARIABLE CHARACTER OF THE γ-RAY EMISSION OF CYG X-3 AND CAS γ-1 IN ENERGY RANGE 10^{12} ev. Fomin, V. P.; Vladimirskii, B. M.; Neshpor, Yu. I.; Stepanyan, A. A. Izv. Krym. Astrofiz. Obs.; 53: 59-65(1975). (In Russian).

During 1972–1973 an observation of objects Cas γ-1 and Cyg X-3 in the energy region 10^{12} ev was continued by means of the ground-based atmospheric Cerenkov technique. The confirmation of the variability of these γ-ray sources was obtained. In December 1972 the increase of emission flux was detected in the direction of Cas γ-1. The duration of this increase was not more than a month. A search for period of Cyg X-3, which was founded in X-rays, gave an affirmative result. The maximum value of flux is $+6{,}3\% \pm 1{,}9\%$. The average of this flux corresponds to an emission of 10^{35} erg · s^{-1}, if the distance to the Cyg X-3 is 10 kpc. (auth)

30659 EVOLUTION OF LOW TEMPERATURE WHITE DWARFS TO THERMONUCLEAR RUNAWAY. Duncan, M. J.; Mazurek, T. J.; Snell, R. L.; Wheeler, J. C. (Univ. of Texas, Austin). Astrophys. Lett.; 17: No. 1, 19-22(1976).

High temperature degenerate cores ($T_c \sim 10^8$ K) are susceptible to thermonuclear runaway at the "ignition line" where nuclear energy generation rates are equal to neutrino energy loss rates. In contrast, low temperature white dwarfs ($T_c \sim 10^6$ K) do not necessarily suffer thermal runaway at the ignition line because the nuclear rates are intrinsically low. Subsequent, adiabatic contraction (due to mass accretion) does lead to a thermal runaway before collapse due to electron capture or general relativistic instability can ensue. (auth)

30660 ABUNDANCE ANOMALIES IN Ap STARS AND THE NOBLE GAS STRUCTURE. Crowley, C. R. (Dominion Astrophysical Observatory, Victoria, B. C.). Astrophys. Lett.; 17: No. 1, 3-5(1976).

A simple diffusion hypothesis is tested in which the noble gas structure of diffusing ions is the dominant factor. The hypothesis fails to predict large overabundances of yttrium and cerium, but shows promise in predicting the lighter lanthanides in many Ap stars. (auth)

30661 SPACE DISTRIBUTION AND KINEMATICS OF INTERMEDIATE POPULATION II STARS. I. Photometry and Spectroscopy in Selected McCormick Proper Motion Fields. Blaauw, A. (Leiden Observatory); Tolbert, C. R.; West, R. M.; Bartaya, R. A. Astron. Astrophys., Suppl. Ser.; 23: No. 3, 393-411(Mar 1976).

uvby and Hβ photometry is reported for over 1000 stars brighter than about 13.5 mag. and located generally in the Galactic polar regions. Spectral types have also been determined for many of the stars. These data constitute the initial phase of an extensive study of the space distribution and kinematics of the Intermediate Population II stars. (auth)

30662 PHOTOMETRIC VARIATIONS OF SOME AP STARS. Renson, P. (Univ., Liege); Manfroid, J.; Heck, A. Astron. Astrophys., Suppl. Ser.; 23: No. 3, 413-417(Mar 1976). (In French).

Photometric observations allowed to deduce periods of 0.9 d for 72G. Pup, between 2.2 and 2.3 d for 77G. Pup and a little less than 2 d for β Hya. The widths of the lines, known for the former and the latter of these stars, agree with the period—

line-width relation. Photometric variations observed for μ Lep, κ^2 Vol, 14 Hya and HD 101065 are also discussed. (auth)

30663 UBV PHOTOMETRIC OBSERVATIONS OF BS AQR. Elst, E. W. (Royal Observatory, Brussels). Astron. Astrophys., Suppl. Ser.; 23: No. 3, 419-428(Mar 1976).

Photometric observations of BS Aqr in the UBV system, obtained during September 1973 at the European Southern Observatory, are presented. (auth)

30664 SEARCH FOR PERIODICITIES IN THE PULSATION OF DELTA SCUTI STARS. II. The Delta Scuti Star 44 Tau (HR 1287). Morguleff, N.; Rutily, B.; Terzan, A. (Observatoire de Lyon, Saint-Genis-Laval, France). Astron. Astrophys., Suppl. Ser.; 23: No. 3, 429-438(Mar 1976). (In French).

New observations of the δ Scuti variable star 44 Tau were carried out in 1970-1971 simultaneously on the 80 cm photometric telescope and with the coude-spectrograph of the 152 cm telescope of the Observatoire de Haute-Provence. The analysis of these observations combined with the previously published ones reveals that no periodicities are present in the pulsation of 44 Tau. (auth)

30665 PHOTOMETRIC ORBIT OF THE ECLIPSING BINARY SYSTEM X TRIANGULI. Bozkurt, S.; Ibanoglu, C.; Guelmen, O.; Gudur, N. (Ege Univ. Observatory, Bornova-Izmir, Turkey). Astron. Astrophys., Suppl. Ser.; 23: No. 3, 439-446(Mar 1976).

The eclipsing binary X Tri was observed photoelectrically in blue and yellow bands. A total of 282 observations were obtained in each color. The system is an Algol-type with a deep primary minimum which gives total eclipse. New epochs of minima were obtained and improved light elements were derived. The light curves were analyzed using two different methods. The resulting elements are presented. (auth)

30666 PROPERTIES AND NATURE OF SHELL STARS. VI. The Shell Star 4 Herculis as an Interacting Binary. Harmanec, P.; Koubsky, P.; Krpata, J.; Zdarsky, F. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 27: No. 1, 47-56 (1976).

Rectified intensity profiles of the Hα and Hβ Balmer lines of 4 Her were studied on 86 coudé spectrograms of 1969-1974. The central intensities of both lines have been found to vary periodically, with the period of velocity changes, 46.194 days, reaching two maxima and minima each cycle. The V/R ratio of the emission peaks of the Hα line also varies in phase with the velocity changes. Definite differences were found in the velocity curves of individual Balmer lines. It is shown that all these data can be reconciled on the assumption that the star is a binary undergoing a variable mass transfer between components. (auth)

30667 RADIO AND OPTICAL OBSERVATIONS OF SOME FLARE STARS. Moiseev, I. G.; Higgins, C. S.; Tovmassian, H. M.; Solomon, L. H.; Patston, G. E.; Chugainov, P. F. Izv. Krym. Astrofiz. Obs.; 53: 150-153(1975). (In Russian).

The results of joint radio-optical observations of flare stars UV Cet, V371 Ori, EQ Peg and GC 22805 AB made in May-August, 1965, are presented. Radio observations have been made with the 64 m radio telescope at Parkes, CSIRO, at frequencies 153, 408 and 1410 MHz. Optical observations have been carried out in Woomera, Crimea and by the group of amateur astronomers in Australia. In total 7 optical flares have been recorded of which 3 were probably accompanied by radio flares. Possible radio flares were observed only at 153 MHz. It is suggested that radio flares have very steep spectra or they occur at lower frequencies only. 11 references. (auth)

30668 DISTRIBUTION OF RED DWARF STARS' FLARES IN OPTICAL RADIATION ENERGY. Krasnobabtsev, V. I.; Gershberg, R. E. Izv. Krym. Astrofiz. Obs.; 53: 154-164(1975). (In Russian).

Assuming the ergodic character of flare activity within an ensemble of stars of similar luminosity a statistical analysis of photographic observations of flares in Pleiades and in Orion has been carried out. Distributions of flares in energy of optical radiation are found within wide ranges of luminosity and age of flare stars in clusters and in solar vicinity. 52 references. (auth)

30669 DEPENDENCE BETWEEN THE AGE AND THE FLARE ACTIVITY OF RED DWARF STARS OF THE SOLAR VICINITY. Shakhovskaya, N. I. Izv. Krym. Astrofiz. Obs.; 53: 165-167 (1975). (In Russian).

The investigation of the motion of 646 red dwarf stars of the solar vicinity shows that the most active UV Cet-type variable stars are members of the young disk population. But less powerful flare activity spreads on members of old disk population too. One case of flare activity on a member of halo population is known. The ratio of the flare stars to the normal stars within those groups of the stellar polulations decreases when the age of the stellar groups increases. The flares are observed more often on the young stars. The flare activity decreases when age of the stars increases, but in some case flare activity is observed on stars older than $5 \cdot 10^9$ years. This result changes the previous opinion that the flare activity is observed only on young stars. 11 references. (auth)

30670 PHOTOELECTRIC OBSERVATIONS OF EM Cep FROM 1971-1972. Rachkovskaya, T. M. Izv. Krym. Astrofiz. Obs.; 53: 168-186(1975). (In Russian).

The photoelectric observations of EM Cep have been carried out with B-filter in the period 1971-1972. It has been shown that there is the light variations of the amplitude over the range $0^m.10-0^m.05$ and that rapid variations of the light are present. The period of the light variations EM Cep was found to be $0^d.806196$. EM Cep probably belongs to type β Cep variables. (auth)

30671 SPECTRUM OF ZETA GEMINORUM CEPHEID IN $\lambda\lambda$10580-11020 A REGION. Shanin, G. I.; Shcherbakov, A. G. Izv. Krym. Astrofiz. Obs.; 53: 187-195(1975). (In Russian).

Spectroscopic observations in the region $\lambda\lambda$10580-11020 Å of ζ Gem cepheid are presented. Eight image-tube spectrograms, with 48 Å/mm dispersion, have been taken with spectrograph of the 50'' telescope. Numerous atomic line identifications and central line intensities of H, Si I, C I, Fe I, Mg I, Sr II, He I, are given for five phases. The λ 10830 Å line of neutral helium appears in absorption and shows the variation with phase. The light maximum equivalent width of helium line is equal or less than 700 mÅ. (17 references) (auth)

30672 ORBITAL SOLUTION OF THE LIGHT CURVE OF MY CYG AND ABSOLUTE DIMENSIONS OF THE SYSTEM. Tremko, J. (Astronomical Inst., Skalnate Pleso, Czech.); Papousek, J.; Vetesnik, M. Bull. Astron. Inst. Czech.; 27: No. 2, 125-126(1976).

The orbital elements of the eclipsing binary MY Cyg derived from our original three color photoelectric light curves and from the spectroscopic results of Popper are presented in the paper. The system consists of two very similar stars and can be classified as the detached one. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 30512, 30540, 30563-30569, 30572, 30574, 30578, 30581, 30584, 30608-30611, 30616, 30618, 30633, 30636, 30657, 30667, 30794, 30796, 30809, and 30821.

30673 X-RAY ASTRONOMY WITH COPERNICUS. Parkinson, J. H.; Culhane, J. L.; Hawkins, F. J.; Sanford, P. W. (University Coll. London, Dorking, Eng.). pp 663-679 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo Brazil (Jun 1974). See CONF-7406116-.

The MSSL X-ray experiment on the Copernicus satellite has several unique capabilities and this paper reviews some recent results. Observations of Cen X-3, GX 5-1 and X-Per are discussed, and it is shown how new locations have enabled optical and radio identifications to be made. The results of mapping the Cas A and Puppis A supernova remnants, the pulsar PSR 0833-45 and the Perseus cluster are presented; these results are interpreted in terms of physical models for the extended X-ray sources, and the correlations of these models with the radio contours are shown for Cas A and Puppis A. Observations of X-ray variability are described for Cyg X-1, Cyg X-3, Her X-1 and Cen X-3. The Cyg X-1 and Cyg X-3 measurements have uniquely identified these sources with optical and infrared objects. (auth)

30674 GAMMA RAY ASTRONOMY (0.1 TO 1000 MeV). Pinkau, K. (Institut fuer Extraterrestrische Physik, Garching, Ger.). pp 681-697 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

The results of γ ray astronomy between 0.1 and 1000 MeV are reviewed. After touching very briefly on properties of instruments used in γ ray astronomy, the presentation concerns itself with the following topics: γ ray pulses and their origin, diffuse γ radiation, γ rays from the galactic plane, emission from localized regions. (auth)

30675 GEOMETRY OF INVERSE COMPTON γ RAY SOURCES. Cowsik, R. (Max-Planck-Institut fuer Extraterrestrische Physik, Garching, Ger.). pp 715-720 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

The results are presented of a calculation of the energy and space distribution of γ rays in the bandwidth 0.1-300 MeV arising from various processes in our galaxy. The processes considered are the Compton scattering of the 2.7°K background photons and of starlight by cosmic ray electrons, and the decay of neutral pions produced in the nuclear interaction of cosmic rays with interstellar matter. Particular emphasis is given to the strong increase in the density of stellar photons close to the galactic center. This leads to a peaking of the γ-ray fluxes in the direction from around the center. The calculated spectral shapes and the anguiar distributions are in agreement with the available observations in the bandwidth $\sim$ 10-100 MeV. (auth)

30676 OSO-7 OBSERVATIONS OF THE X-RAY NOVA 3U 1543-47. Li, F.K.; Sprott, G.F.; Clark, G.W. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology). Astrophys. J. 203: No. 1, 187-192 (1 Jan 1976).

The intensity and spectrum of the transient X-ray source 3U 1543-47 were measured by the MIT X-ray detectors on the OSO-7 satellite on 13 occasions between 1971 November and 1972 December. The results, together with observations of the same object by the *Vela* and *Uhuru* satellites, can be described in terms of four qualitatively distinct phases in the X-ray light curve: (1) outburst (1971 July 26); (2) relatively steady intensity and spectrum (1971 August 1 to 1971 November 20); (3) rapid decrease in intensity and decrease in apparent temperature (1971 November 20 to 1972 January 6); (4) irregular intensity fluctuations with complex spectra (1972 January 6 onward). The term "X-ray nova" is proposed to characterize this and similar transient sources, and a new model for such X-ray novae is proposed. (auth)

30677 SCO X-1 AND CYG X-2 AS BINARY SYSTEMS. Katz, J. I. (Cornell Univ., Ithaca, N.Y. (USA). Center for Radiophysics and Space Research; Institute for Advanced Study, Princeton, N.J. (USA)). Astron. Astrophys.; 39: No. 2, 241-244(Mar 1975).

Sco X-1 and Cyg X-2 resemble old novae spectroscopically and photometrically, which has led to the suggestion that they are binary systems. The energy distribution and emission-line spectrum of Sco X-1 are very different from those of the well-known binary x-ray sources. These differences may be accounted for by a small inclination angle, a small orbit size, the observed softer x-ray spectrum, and a companion star of low intrinsic luminosity in the Sco X-1 system. Cyg X-2 has the properties expected of a cooler version of HZ Her, viewed from a small inclination angle. (DE)

30678 KINEMATICAL DESCRIPTION OF QUASI-STELLAR OBJECTS. Alvarez, E.; Bel, L.; Gracia-Bondia, J. (Universidad Autonoma de Madrid (Spain). Departamento de Fisica Teorica). Astron. Astrophys.; 40: 381-386(1975).

The General Relativistic Kinetic theory is used to describe the cosmological fluid which is considered as a mixture of two gases: the gas of galaxies and the gas of Q.S.O.'s. Assuming a generalized equilibrium distribution function for the latter, together with rather natural supplementary simplifying assumptions, the statistical observables of the model is derived. Comparing the theoretical results with the observational data, it is in principle plausible to describe the gas of Q.S.O.'s by a rather broad distribution function; this would mean that an important number of these are Kinematically Peculiar Objects, i.e., objects having high velocities with respect to the mean motion of the cosmological fluid. (DE)

30679 OPTICAL BRIGHTNESS AND POLARIZATION OF QUASARS AND RELATED OBJECTS. McGimsey, B. Q. Jr. Gainesville, FL; Univ. of Florida (1974). 140p. University Microfilms Order No. 75-19,361.

Thesis (Ph. D.).

Photographic monitoring of over 130 quasars and related objects has shown definite optical variability to be present in nineteen of these objects and suspected variability in forty-four others. Regular observations of the optically violent variables OB 338, OX 074, PSK 0518 +16, PSK 2345-16, NRAO 512, and 3C 371 have revealed that these objects continue to undergo violent optical outbursts of a magnitude or more with the flare and subsequent return to minimum sometimes occurring within a few weeks. In addition, optical variability was observed for the first time in the objects PKS 0202-17, PKS 0222-23, PKS 1252 +11, and NRAO 140. Both OQ 208 and PKS 0222-23 showed a total range of variability of a magnitide or more. The optically violent quasar 3C 446 underwent a 2./sup m/5 flare in 1974 with an extremely rapid decay time. Two types of characteristic variability were observed. The first was a violent optical outburst with rapid rise and decay times. The second type of characteristic variability was a slowly varying component which appeared as a gradual rise and fall in optical brightness. There is observational indication that major flares in optically violent objects tend to be followed by a succession of minor flares of decreasing amplitude superimposed upon the decline in brightness following the major flare. This effect was observed in NRAO 512, OX 074, PKS 2345-16, PKS 2209 +08, and possibly OQ 208 and PKS 0222-23. Optical linear polarimetric observations were conducted photographically on BL Lacertae, 3C 120, and 3C 273. These observations indicate that the peculiar object BL Lac has a very large, rapidly varying linearly polarized component. There seems to be a positive correlation between the optical activity of an object and the magnitude and variability of its linearly polarized component. (Diss. Abstr. Int., B)

30680 THREE-COLOR PHOTOGRAPHIC PHOTOMETRY OF ACTIVE QUASISTELLAR RADIO SOURCES. Hackney, K. R. H. Gainesville, FL; Univ. of Florida (1973). 230p. University Microfilms Order No. 75-19,408.

Thesis (Ph. D.).

Statistically significant optical variations were detected at Rosemary Hill Observatory in studies of the quasars and quasar-like objects PKS 0048-09, PSK 0336-01, PKS 0420-01, PKS 0518+16, PKS 0735+17, PKS 2111-25, PKS 2209+08, PKS 2354-11, OB 338, OI 318, OK 290, and OL 318. These sources comprised about 40 percent of the sample of 28 objects for which numerous photographic plates were measured with an iris photometer. The detection of variability in the objects PKS 2111-25, PKS 2209+08, PKS 2354-11, OB 338, and OL 318 supports the previously suggested optical identifications that were based only on color and proximity to the radio source positions. The large-amplitude variability of PKS 0735+17 is especially noteworthy in connection with its featureless optical spectrum and its consequent similarity to the active peculiar sources BL Lac and OJ 287. Detailed observation revealed that the quasar PKS 0906+01 continues to exhibit one-magnitude monthly flares that erupt apparently at random from a slowly varying base component. Observation of the quasar 3C 345 disclosed the second apparition of a one-magnitude plateau of about one-year duration, following by about 1200 days its initial appearance in the light curve. Substantial interday variation of BL Lac and 3C 120 and possible intraday variation in OJ 287 were revealed in Rosemary Hill observations of these sources made in cooperation with other observatories. The amplitudes of the variations of BL Lac and OJ 287 were found to be greater for shorter wavelengths in the present UBV observations. The B-V color index of BL Lac increased by 0.18 magnitude on the average for a one-magnitude decrease in V over the 1971 and 1972 observing seasons. This result is interpreted simply in terms of a two-component synchrotron source model. (Diss. Abstr. Int., B)

30681 SEARCH FOR SHORT TIME-SCALE RADIO FLUCTUATIONS. Rudnick, L. Princeton, NJ; Princeton Univ. (1974). 173p. University Microfilms Order No. 75-20,657.

Thesis (Ph. D.).

A number of extragalactic radio sources and spiral galaxies were studied for broadband radio fluctuations, in the hope of measuring the density of the intergalactic plasma. Limits in the range of 100 to 500 mfu rms were set on possible fluctuations for time-scales of seconds or less. A search was also made for broadband fluctuations and highly dispersed pulsars in the Galaxy, in the direction of the Galactic Center, and along tangents to prominent spiral arms. No new pulsars were found with dispersion measures less than approximately 1500 P pc cm^{-3}, where P is the pulsar period, in seconds, and with apparent luminosities greater than about 20 mfu. (Diss. Abstr. Int., B)

30682 ABELL CLUSTERS AND RADIO SOURCES AT 1400 MHz. Kalinkov, M.; Stavrev, K. C. R. Acad. Bulg. Sci.; 28: No. 7, 867-869(1975).

30683 KINEMATICS OF RELATIVISTIC EJECTION. Behr, C. (Department of Mathematics, University of Mainz, Germany); Schucking, E.L.; Vishveshwara, C.V.; Wallace, W. Astron. J. 81: No. 3, 147-154 (Mar 1976).

Radio objects in quasars have been observed with apparent transverse velocities that exceed the speed of light. Ejection of such bodies at relativistic speeds appears to be a possible explanation for the puzzling observational data. A geometrical construction for the observable parameters of relativistic motions in a Friedman universe is employed to study the optical phenomena associated with relativistic ejection. The results obtained are applied to some specific observations of 3C 279 as an example. (auth)

30684 3C 303: A SOURCE WITH UNUSUAL RADIO AND OPTICAL PROPERTIES. Kronberg, P.P. (Max-Planck-Institut für Radioastronomie, Bonn, West Germany). Astrophys. J. Lett. 203: No. 2, L47-L48 (15 Jan 1976).

A high-resolution radio map of 3C 303 made with the NRAO interferometer, combined with deep exposure plates of the optical field, show that 3C 303 has an unusual radio structure, and that *each* of the

two main radio components coincides with an optically visible system. The compact, flat spectrum component coincides with the nucleus of a 17th magnitude galaxy, and the extended steep spectrum component appears to be associated with a compact trio of faint objects, 2 at the 22 mag level and one of ~19.5 mag which has a distinctly nonstellar spectrum. (auth)

30685 RADIO EMISSION FROM A SOURCE NEAR THE FLARE STAR AD LEONIS. Robinson, R.D.; Slee, O.B. (Division of Radiophysics, CSIRO, Sydney); Little, A.G. Astrophys. J. Lett. 203: No. 2, L91-L93 (15 Jan 1976).

A weak, probably variable, source has been located 1'.85 southeast of the flare star AD Leo. Characteristics of this source are discussed, and an interpretation is given based on plasma emission from a stellar companion to the flare star. (auth)

30686 GRAVITATIONAL–WAVE BURSTS FROM THE NUCLEI OF DISTANT GALAXIES AND QUASARS: PROPOSAL FOR DETECTION USING DOPPLER TRACKING OF INTERPLANETARY SPACECRAFT. Thorne, K.S. (California Institute of Technology, Pasadena, California, U.S.A.); Braginsky, V.B. Astrophys. J. Lett. 204: No. 1, L1-L6 (15 Feb 1976).

It is likely that supermassive black holes ($M \simeq 10^6$ to $10^{10}\ M_\odot$) exist in the nuclei of many quasars and galaxies. The collapse which forms these holes and subsequent collisions between them should produce strong, broad-band bursts of gravitational waves: for a source of mass M at the Hubble distance of $\sim 10^{10}$ light-years, the dimensionless amplitude would be $h \sim 2 \times 10^{-17} \times (M/10^6\ M_\odot)$, and the duration of the burst would be $\tau \sim (90\ s) \times (M/10^6\ M_\odot)$. Such bursts might arrive at Earth as often as 50 times per year—or as rarely as once each 300 years. The detection of such bursts may be possible within the next few years using dual-frequency Doppler tracking of interplanetary spacecraft. (auth)

30687 THE UNUSUAL H_2O MASER SOURCE NEAR HERBIG-HARO OBJECT NUMBER 11. Lo, K.Y.; Morris, M. (Owens Valley Radio Observatory, California Institute of Technology); Moran, J.M.; Haschick, A.D. Astrophys. J. Lett. 204: No. 1, L21-L24 (15 Feb 1976).

Water emission spectra of an unusual source near Herbig-Haro (HH) 11 have been monitored over a 14-month period. Variations in the intensity and the radial velocity of the emission are noticeable on time scales as short as one day. At any given time, only one or two velocity components are present in the spectrum. The variations are such that each component appears and disappears at a fixed radial velocity, and new components appear at seemingly random velocities within a 40 km s^{-1} range. It is suggested that the exciting source is losing mass via a stellar wind, and that the H_2O emission arises in the transition region between the cavity created by the stellar wind and the surrounding molecular medium. The proposed model can be tested by VLBI observations; an accurate position for the H_2O maser source is required to determine the physical relationship between the maser source and the infrared or HH objects. (auth)

30688 NEUTRAL HYDROGEN IN THE W41 REGION. Gordon, C.P.; Gordon, K.J. (Five-College Astronomy Department, Hampshire College, Amherst, Massachusetts); Jacobson, M.R. Astrophys. J. 203: No. 3, 593-599 (1 Feb 1976).

We have made observations of neutral-hydrogen emission and absorption in the W41 region, with angular resolution of 10' and velocity resolution of 2 km s^{-1}. The most probable model for the W41 complex is as follows: G22.8–0.3 is at a distance of ~6 kpc; G23.1–0.3 is composed of nonthermal radiation from a supernova remnant at $4.6 \lesssim d \lesssim 7$ kpc plus possibly a weak extension of the thermal component G22.8–0.3; G23.4–0.2 is not associated with either of these sources and is located at a distance of either ~8 or ~11 kpc. The most prominent hydrogen feature in the region covers a 1°.5 diameter area centered on G23.4–0.2 in the velocity range $77 < V_{LSR} < 102$ km s^{-1}. This feature, located near the inner Lindblad resonance of the Galaxy, can most logically be interpreted as the end-on view of an elongated object—either an arc of a dispersion ring or a spiral-arm segment, possibly arising from the end of a bar in the central region of the Galaxy. (auth)

30689 POLARIZATION OF X–RAYS FROM CYGNUS X-1: A TEST OF THE ACCRETION DISK MODEL. Lightman, A.P.; Shapiro, S.L. (Center for Radiophysics and Space Research, Cornell University). Astrophys. J. 203: No. 3, 701-703 (1 Feb 1976).

Measurements of the polarization of X-rays from Cyg X-1 can yield significant information about the structure of the accretion disk which produces the observed spectrum. In particular, both the physical geometry (sensitive to large changes in the viscosity) and also the soft X-ray cutoff of the inner region of the disk have distinguishable effects on the observed polarization. (auth)

30690 HIGH-ENERGY ASTRONOMY IN THE U.K. Pounds, K. A. (Leicester Univ., Eng.). Astronaut. Aeronaut.; 14: No. 4, 20-24(Apr 1976).

Highlights of British research on radio galaxies, x-ray astronomy, and hot black holes are described. The prospects for international collaboration on space projects, in particular x-ray astronomy, are discussed. (BJG)

30691 OBSERVATIONS OF RADIO SOURCES AT 3,9 mm. Efanov, V. A.; Zinchenko, I. I.; Kislyakov, A. G.; Kuznetsov, I. V.; Moiseev, I. G.; Naumov, A. I. Izv. Krym. Astrofiz. Obs.; 53: 144-149(1975). (In Russian).

The results of measurement of flux density of 21 radio sources at 3,9 mm are given. Observations are made with the 22-meter radiotelescope of the Crimean observatory in August-September 1973. The sensitivity of radiometer is 0,5° K at $\tau = 1$ sec. (26 references) (auth)

30692 SYNCHRONIZATION OF TIME SCALES AT SITES OF VERY LONG BASE INTERFEROMETER FROM OBSERVATIONS OF MASERS SOURCES OF COSMIC RADIO EMISSION. Alekseev, V. A.; Gatelyuk, E. D.; Lipatov, B. N.; Nikonov, V. N.; Sizov, A. S.; Chikin, A. I.; Shchekotov, B. V. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 12, 1777-1785(1975). (In Russian).

The possibilities of synchronizing time scales at the sites of a very-long-base interferometer (VLBI) have been analysed from observations of intensive cosmic maser radio emission sources. The results of the experiment allowing to synchronize the time scale at the sites at the distance of ~1000 km with an accuracy of 1 μc are presented. (auth)

30693 SOFT X RAYS FROM IC443. Shulman, S.; Naranan, S.; Fritz, G.; Friedman, H. (Naval Research Lab., Washington, DC). Astrophys. Lett.; 17: No. 1, 15-17(1976).

A rocket survey, using large area proportional counters, has detected X-ray emission from IC443 in the 0.6–1 keV energy band. The flux is greater than is predicted by the spectra of Winkler and Clark (1974). If the emission is thermal, the low energy data can be made to fit by adding a second, lower temperature component. (auth)

30694 HIGH RESOLUTION OBSERVATIONS OF 3C 33 AT 327 MHz. Gopal-Krishna; Joshi, M. N.; Ananthakrishnan, S. (Radio Astronomy Centre, Ootacamund, India). Astrophys. Lett.; 17: No. 1, 11-14(1976).

Lunar occultation and interplanetary scintillation observations of the double radio source 3C 33 at 327 MHz are presented. The occultation observations with a resolution of 2.6 arc sec, which is nearly 100 times smaller than the total extent of the source, have revealed fine structure similar to that found in Cygnus A by Hargrave and Ryle. A faint continuous bridge connecting the two components has also been detected. A scintillating object of size ~½ kpc, which is nearly 700 times smaller than the component separation, is found to be located in or near the southern compact component and may be a product of fragmentation of the component due to fluid dynamic instabilities. The object is likely to be a transient phenomenon because of its high internal pressure compared to the ram pressure of the medium. (auth)

30695 CORRELATION OF SCINTILLATION VISIBILITY WITH FLUX DENSITY AND ANGULAR EXTENT OF EXTRAGALACTIC RADIO SOURCES. Swarup, G. (Tata Inst. of Fundamental Research, Ootacamund, India); Bhandari, S. M. Astrophys. Lett.; 17: No. 1, 31-36(1976).

The interplanetary scintillation visibility of extragalactic radio sources, defined as the fraction of flux density originating in compact components with angular size less than about 1 arc sec, is statistically shown to increase with decreasing flux density and decreasing overall angular size. These relations can be satisfactorily explained if a majority of extragalactic radio sources have fine structures in between those found in recent high resolution studies of Cygnus A and 3C 33 and if most of the weaker sources are located farther away. It is also suggested that the angular size of compact components found by the method of interplanetary scintillations refers to different structures in radio sources at different redshifts and their use as "rigid rods" for cosmological studies should, therefore, be treated with caution. (auth)

30696 RADIO SOURCE SAGITTARIUS A. Gopal-Krishna; Swarup, G. (Tata Inst. of Fundamental Research, Ootacamund, India). Astrophys. Lett.; 17: No. 1, 45-47(1976).

The high resolution observations of the radio source Sgr A made between 160 MHz and 5 GHz are compared. The western peak, known as Sgr A-West, consists of both thermal and nonthermal discrete components. Sgr A-East has a nonthermal origin with the discrete components superimposed on a background component of size ~3 × 5 arc min. The discrete nonthermal components in Sgr A have a steeper spectrum than the background component and may be parts of a supernova remnant shell. (auth)

Solar Phenomena

Refer also to abstracts 29078, 30506, 30507, 30547, 30548, 30583, 30638, 30839, 30855, 30868, 30960, 30979, 31000, 31001, and 31202.

30697 (AD/A-008454) FINE STRUCTURE OF THE SOLAR CHROMOSPHERE. Interim Report, 1 Oct 1973–30 Sep 1974. Bhavilai, R. (Chulalongkorn Univ., Bangkok (Thailand)). 17 Mar 1975. 14p. NTIS $3.25.

The sun was observed in the Hα line and around it in the quiet regions and in the active regions. Preliminary results were obtained concerning the lifetimes and changes of the fine structures in the quiet regions and the active regions, the bright streaks, and the identification of the Hα plages and the photospheris faculae. (GRA)

30698 (COM-75-50279-40/SL) H-α SYNOPTIC CHARTS OF SOLAR ACTIVITY FOR THE PERIOD OF SKYLAB OBSERVATIONS, May 1973–March 1974. McIntosh, P. S. (World Data Center A for Solar-Terrestrial Physics, Boulder, Colo. (USA)). Feb 1975. 38p. (UAG–40). Paper Copy Available from National Climatic Center, Federal Bldg. Attn: Publications, Asheville, N. C. 28801. $25.20/Year. $0.56/Copy This Issue.

Special charts were prepared of the slowly-varying large-scale features of chromospheric solar activity covering the period of the manned and unmanned Skylab observations, May 28, 1973, to February 3, 1974. The charts are based on once-daily standard Hα observations which have been interpreted in terms of large-scale magnetic field regions according to a technique previously described. The data are given on the synoptic time scale of a solar rotation. (GRA)

30699 (COM-75-50279-41/SL) Hα SYNOPTIC CHARTS OF SOLAR ACTIVITY DURING THE FIRST YEAR OF SOLAR CYCLE 20, OCTOBER 1964–AUGUST 1965. McIntosh, P. S. (World Data Center A for Solar-Terrestrial Physics, Boulder, Colo. (USA)). Mar 1975. 31p. (UAG–41). Paper Copy Available from National Climatic Center, Federal Bldg. Attn: Publications, Asheville, N. C. 28801. $25.20/Year, $0.48/Copy This Issue.

Solar activity during the period October 28, 1964, through August 27, 1965, is presented in the form of charts for each solar rotation constructed from observations made with the chromospheric Hα spectral line. These Hα synoptic charts are identical in format and method of construction to those published for the period of Skylab observations. The sunspot minimum marking the start of Solar Cycle 20 occurred in October, 1964; therefore, charts represent solar activity during the first year of this solar cycle. (GRA)

30700 (INIS-mf-1888, pp 14-78) HIGH TIME RESOLUTION ANALYSIS OF SOLAR FLARES OBSERVED ON THE ESRO TD-1A SATELLITE. Chapter 2. Hoyng, P.; Brown, J. C.; Beek, H. F. van. 23 Jun 1975.

This chapter will be published in Solar Phys.; 61 refs., 28 figs., 7 tables.

In studies on hard x-ray emission from solar flares and on cyclotron radiation from a cold magnetoplasma. (Rijksuniversiteit Utrecht (Netherlands)).

The Utrecht hard solar x-ray spectrometer S-100 on board the ESRO TD-1A satellite covers the energy range above 25 keV in 12 logarithmically spaced energy channels. The time resolution is 1.2 s for the four low energy channels (25–90 keV) and 4.8 s for the remaining. Observations of a number of solar flares in the period 12/03/72–01/10/73 are presented, among which are four flares from the highly active 1–8 August 1972 period. The observations are entirely free from instrumental defects. Spectral parameters (thick target parameters) for these flares are presented and analyzed. The suggestion is made that the hard x-ray observations admit a classification in two groups: the interpretation of observed breaks in the x-ray photon spectra is discussed. A time series analysis of the hard x-ray time profiles has been made. Specifically this includes (1) noise properties, (2) the question of a correct definition of time scales involved in the hard x-ray emission and a discussion of their meaning and application, (3) existence of periodicities, (4) timing differences between short "spikes" at different energies. Correlations between various (derived) hard x-ray emission parameters have been looked for. A remarkable new feature is the good correlation between the thick target parameter of the large August 4, 1972 event. Finally, a few implications from the observations for existing (x-ray) flare models are discussed. In particular, the possible physical differences between the two groups of hard x-ray bursts is looked into. Also the existence of streams of fast electrons is discussed; as these streams are very strong, they have important consequences for flare theory.

30701 (INIS-mf-1888, pp 79-85) INTERPRETATION OF HARD X-RAY AND MICROWAVE EMISSION OF THE FLARE OF MAY 18, 1972, UT 1406. Chapter 3. Hoyng, P.; Stevens, G. A. 23 Jun 1975.

From 1st European astronomical meeting; Athens, Greece (1972).

This chapter has been published in Solar Activity and Related Interplanetary and Terrestrial Phenomena, J. Xanthakis (ed.), 1973, v. 1, p. 97; 6 refs., 4 figs.

In studies on hard x-ray emission from solar flares, and on cyclotron radiation from a cold magnetoplasma. (Rijksuniversiteit Utrecht (Netherlands)).

An analysis of the flare of May 18, 1972, UT 1406, observed with the Utrecht hard solar x-ray spectrometer on board the ESRO satellite TD-1A is presented. Included in this analysis is the pertinent GHz radio data of this event. The proton density in the source region is inferred to be at least 5.10^9 cm^{-3}. The radio spectra are found to agree with calculations of Holt and Ramaty. The radio and x-ray data together result in a consistent set of parameters.

30702 (INIS-mf-1888, pp 109-122) PHYSICAL CONDITIONS OF ELECTRON ACCELERATION IN SOLAR FLARES. Chapter 5. Hoyng, P. 23 Jun 1975.

24 refs., 1 fig.

In studies on hard x-ray emission from solar flares and on cyclotron radiation from a cold magnetoplasma. (Rijksuniversiteit Utrecht (Netherlands)).

On the basis of a few crucial observational facts, a discussion is given on what physical conditions might prevail in the electron acceleration region of ordinary solar flares. It is argued that electrons are probably accelerated by resonant interactions with electron plasma waves (Langmuir waves), and the possiblilites of generating these from current sheets are discussed. Because the sheet volume itself is orders of magnitude too small to contain the observed number of fast electrons, their acceleration must take place outside the sheet. It is argued that nonlinear interactions are negligible and as a consequence, efficient electron acceleration can occur.

30703 (INIS-mf-1893, pp 35-45) 3. A UNIFIED EXPLANATION OF SOLAR TYPE IV dm CONTINUA AND ZEBRA PATTERNS. Kuijpers, J. 14 Apr 1975.

10 refs., 5 figs.

In collective wave-particle interactions in solar type IV radio sources. (Rijksuniversiteit Utrecht (Netherlands)).

Both type IV dm continuum radiation and zebra patterns can have their origin in plasma waves at the upper hybrid frequency which are excited by a loss-cone distribution of fast electrons superposed on the thermal background. If the inverse fractional density of fast electrons surpasses the ratio of the electron plasma frequency to the electron cyclotron frequency, instability only exists at those places in the corona where this ratio is an integer thus giving rise to zebra patterns. Some observations in favor of the present explanation are discussed. Upper limits to the magnetic field strength and the fast particle density in the source are derived from the observations.

30704 (INIS-mf-1893, pp 49-70) 5. GENERATION OF INTERMEDIATE DRIFT BURSTS IN SOLAR TYPE IV RADIO CONTINUA THROUGH COUPLING OF WHISTLER SOLITONS AND LANGMUIR WAVES. Kuijpers, J. 14 Apr 1975.

5 figs., 26 refs., 3 tables.

In collective wave-particle interactions in solar type IV radio sources. (Rijksuniversiteit Utrecht (Netherlands)).

The possible generation of intermediate drift bursts in type IV dm continua through coupling between whistler waves traveling along the magnetic field, and Langmuir waves excited by a loss-cone instability in the source region is elaborated. We investigate the generation, propagation and coupling of whistlers. It is shown that the superposition of an isotropic background plasma of 10^6 K and a loss-cone distribution of fast electrons is unstable for whistler waves if the loss-cone aperture 2α is sufficiently large (sec $\alpha \cong 4$); a typical value of the excited frequencies is $0.1\omega_{ce}$ (ω_{ce} is the angular electron cyclotron frequency). The whistlers can travel upwards through the source region of the continuum in the form of solitons with a velocity of 21.5 v_A (v_A is the Alfvén velocity). Coupling of the whistlers with Langmuir waves into escaping electromagnetic waves can lead to the observed intermediate drift bursts, if the Langmuir waves have phase velocities around the velocity of light. In our model, the instantaneous band width of the fibers corresponds to a frequency of $0.1-0.4\omega_{ce}$ and leads to estimates of the magnetic field strength in the source region. These estimates are in good

agreement with those derived from the observed drift rate, corresponding to $21.5v_A$, if we use a simple hydrostatic density model.

30705 SOLAR SELF-GRAVITY-INDUCED ELECTROSTATIC REDSHIFT. Smith-Hanni, A. L. Helv. Phys. Acta; 48: No. 4, 548-551(1975).

The possibility of electrostatic redshifts produced by self-gravity-induced electric fields, as a mechanism for explaining residual shifts remaining in solar spectral lines after gravitational redshift corrections have been made, is considered. (auth)

30706 SEARCH FOR THE SOURCES OF THE SOLAR WIND IN THE 9.1 CM BRIGHTNESS TEMPERATURE. George, R. G. Provo, UT; Brigham Young Univ. (1975). 152p. University Microfilms Order No. 76-697.

Thesis (Ph. D.)

The sources of solar wind streams have been the object of intensive research for many years, but the various ideas of where and how streams originate on the sun are still incomplete and contradictory. The present study is an attempt to find the solar wind sources by mathematically approximating the 9.1 cm brightness temperature which would be expected at the foot of spacecraft-measured solar wind streams and by then comparing it with actual radio brightness temperature measurements. Several significant results were found from an analysis of the correlation results. Most plasma emanating from the sun was found to come from high solar latitudes and to deviate significantly from the normally expected east-west path in the low corona. Magnetic channeling causes correlation studies to fail when the sun's magnetic configuration is unstable. The travel time of the plasma from the sun's 9.1 cm emission level to the earth is often more than a month. (Diss. Abstr. Int., B)

30707 SOLAR EUV FLUX MODELS CONSISTENT WITH IONOSPHERIC ION COMPOSITION OBSERVATIONS. Chakrabarty, P.; Mitra, A. P. (National Physical Lab., New Delhi). pp 335-343 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

A search was made for appropriate solar EUV flux models that would be consistent with all ionospheric ion composition measurements. The observational results are reproduced and some consistency in O^+, NO^+ and O_2^+ obtained with the scheme presented. A consequence is that ion composition results above 140 km yield the CIRA 1972 type of neutral atmospheric model as the most consistent with all three (low, medium and high) phases of solar activity. There is, however, still a major discrepancy between observed and theoretical O_2 production rates for heights below 140 km, and the requirement is that Ly β and the soft X-rays in particular should be substantially increased within the framework of present models. (auth)

30708 CHARACTERISTICS OF INTERPLANETARY PLASMA NEAR THE EARTH OBSERVED DURING THE SOLAR EVENTS OF AUGUST 1972. Cambou, F. (Paul Sabatier Univ., Toulouse); Vaisberg, O. L.; Espagne, H.; Temny, V. V.; d'Uston, C.; Zastenker, G. N. pp 461-469 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

The French-Soviet experiment Calipso, launched June 29, 1972, aboard the Prognoz 2 satellite and put into a very eccentric orbit, has made it possible to record fluctuations in interplanetary plasma characteristics. The disturbances caused by the intense solar activity of early August 1972 were investigated using electron and ion measurements between 0.4 and 20 keV per unit charge. These data allow a correlation between disturbances in the interplanetary medium and the sequence of solar events. Plasma fluxes having speeds greater than 1700 km s^{-1} and temperatures above 10^3 eV were detected. The plasma characteristics during this event as deduced from data from various other satellites differ somewhat from those observed by Calipso, suggesting that the shock wave is non-spherical and the plasma configuration with energetic trapping is limited. (auth)

30709 SOLAR CORONA AS OBSERVED DURING THE 30 JUNE 1973 SOLAR ECLIPSE ON BOARD CONCORDE 001. Lena, P. (Observatoire, Meudon, France); Hall, D.; Soufflot, A.; Viala, Y. pp 579-583 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

Observations of the F-corona of the sun have been made in the 10 μm (infrared) region during the eclipse of June 30, 1973. Use of the supersonic aircraft Concorde 001 permitted 74 minutes of observation during totality and greatly reduced problems due to sky noise. The plane of the ecliptic was scanned over heliocentric distances from 3 to 19 solar radii off the east limb. Bright features previously observed at shorter wavelengths, notably emission at 4 solar radii are evident on the 10 μm scans, strongly indicating that the radiation is due to thermal emission by dust. The specific intensity in the $4R_\odot$ feature is 6.9×10^{-8} W cm^{-2} $ster^{-1}$ μ^{-1} higher than the intensity 22 arc minutes above the ecliptic. Spectra were taken at $3R_\odot$ near the ecliptic. (auth)

30710 INVESTIGATION OF SOLAR X-RAYS FROM THE LUNAR SURFACE, CARRIED OUT ON LUNOKHOD 2. Kocharov, G. E.; Victorov, S. V.; Chesnokov, V. I. (Ioffe Inst. of Physics and Tech., Leningrad). pp 633-636 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

A special detector for measurements of solar X-rays in the energy range 5 to 30 keV has been installed in an X-ray fluorescence spectrometer RIFMA-M aboard Lunokhod 2. The design and characteristics of this instrument are described. Measurements of the quiet sun and the characteristics of a weak X-ray burst (which may or may not be of solar origin) on January 17, 1973, are presented. The duration of the burst was about 10 min, the rise time 1 min, and the total X-ray flux 10^{-7} erg cm^{-2} s^{-1}. (auth)

30711 INVESTIGATION OF SOLAR FLARE X-RAY SPECTRA IN THE HYDROGEN-LIKE Fe ION REGION. Grineva, Yu. I.; Karev, V. I.; Korneev, V. V.; Krutov, V. V.; Mandel'stam, S. L.; Safronova, U. I.; Urnov, A. M.; Vainstein, L. A.; Zhitnik, I. A. (Lebedev Inst. of Physics, Moscow). pp 637-640 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

Results of preliminary studies of solar X-ray flare spectra in the region of the Fe XXVI resonance line are given. The spectra were obtained on board the Intercosmos 4 satellite. The composite spectrum obtained from ten scans reveals some peaks. Three peaks could correspond to the Kβ (Fe), Lα (Fe XXVI) and its satellite lines; this identification, however, leads to significant difficulties. A short discussion of the problem is given. (auth)

30712 SOLAR SUBFLARE X-RAY SPECTRUM. Beigman, I. L.; Grineva, Yu. I.; Korneev, V. V.; Krutov, V. V.; Mandel'stam, S. L.; Vainstein, L. A.; Vasil'ev, B. N.; Zhitnik, I. A. (Lebedev Inst. of Physics, Moscow). pp 641-650 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

The subflare spectrum in the range 7.8-19.4 Å was obtained with KAP crystal spectrometers aboard the Vertical 2 rocket. The absolute fluxes for the lines are given. The temperature of 5×10^6 K and emission measure of 6×10^{48} cm^{-3} were derived from the Mg XI-XII, Ne IX-X and Na X-XI lines. Analyses of the Lyman decrements for Ne X and O VIII series and the relative intensities of the Fe XVII 2p-nd lines were made. The abundances of Ne, Na, Fe and O were estimated, and are discussed. (auth)

30713 STRUCTURE OF THE SUN'S POLAR CAP AT WAVELENGTHS 240 TO 600 A. Bohlin, J. D.; Sheeley, N. R.; Tousey, R. (Naval Research Lab., Washington, DC). pp 651-656 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

An NRL slitless spectrograph obtained monochromatic images of the sun in the extreme ultraviolet (XUV) 170-630 Å. The solar poles exhibited a complex variety of phenomena: He II 304 Å showed a depressed intensity and lack of supergranular network that is characteristic of so-called coronal holes; "super spicules" of He II 304 Å exist throughout the polar cap; the limb brightening of Ne VII 465 Å is wider and higher over the polar cap; and Mg IX 368 Å and other coronal lines exhibit polar plumes such as observed at an eclipse. (auth)

30714 SOLAR NEUTRINOS: A SCIENTIFIC PUZZLE. Bahcall, J. (Inst. for Advanced Study, Princeton, NJ); Davis, R. Jr. Science; 191: No. 4224, 264-267(23 Jan 1976).

The solar neutrino problem is discussed and the Brookhaven Experiment reviewed. Speculations about the nature of the solar interior are examined. An experiment using the capture of neutrinos by ^{7}Li to form ^{7}Be is proposed to resolve the solar neutrino question. 24 refs. (BJG)

30715 REMARKS ON THE PRESENCE OF SOME WEAK LINES IN THE SOLAR PHOTOMETRIC SPECTRAL RANGE λ6105 TO λ6150. Baeck, N. (Rijksuniversiteit, Ghent). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 5, 706-710(1975).

Using a newly proposed method of analysis of the solar photo-

metric spectrum in the range λ6105 to λ6150, with the spectral data published by Delbouille, Neven, and Roland, all lines mentioned in the S.R.R.T. are confirmed with the exception of the eight weak lines mentioned in a table. Eleven weak lines quoted in the R.R.T. but rejected in the S.R.R.T., reappear in the analysis (column λ_0 of Table II). Tentative identifications are proposed for five new lines while two identifications given in the R.R.T. are confirmed. (auth)

30716 SOLAR PHOTOSPHERIC SPECTRUM NEAR WAVELENGTH 6138.5 A. Baeck, N.; Dingens, P.; Steyaert, H. (Rijksuniversiteit, Ghent). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 5, 711-714(1975).

The blend mentioned in the S.R.R.T. at 6138.43 Å was resolved with a new decomposition technique. The presence of Ti I and Y I is confirmed. Besides these two lines the results also reveal a line at 6138.661 Å, corresponding with a line of Ar II. (auth)

30717 EMISSION OF Li-LIKE IONS FROM THE SOLAR CORONA. Flower, D. R.; Nussbaumer, H. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Gruppe fuer Atom- und Astrophysik). Astron. Astrophys.; 39: No. 2, 295-302(Mar 1975).

The intensities of the solar XUV emission lines of the lithium-like ions O^{+5}, Ne^{+7}, Mg^{+9} and Si^{+11}, observed both by rocket and satellite, have been analyzed. The coronal contribution to the observed intensities is shown to be important even for O^{+5}, whose ionization curve maximizes at 3×10^5 K. Indirect excitation via the continuum and highly excited bound states must be included when interpreting the emission from levels of principal quantum number, $n \geq 3$. The coronal electron temperature, as deduced from off-limb OSO 6 observations, is found to be remarkably stable at about 1.6×10^6 K over the period of one month during which the observations were made. From the same spectra, the relative abundances of O, Ne and Mg are deduced. (DE)

30718 STUDY OF He I EMISSION LINES IN THE SOLAR ATMOSPHERE. Pt. 3. The Triplet-Singlet Line Intensity Ratios in Solar Prominences. Heasley, J. N.; Tandberg-Hanssen, E. (National Center for Atmospheric Research, Boulder, Colo. (USA). High Altitude Observatory); Wagner, W. J. (Air Force Cambridge Research Labs., Sunspot, N. Mex. (USA). Sacramento Peak Observatory). Astron. Astrophys.; 40: 391-395(1975).

Observations of the He I spectrum for the quiescent prominence of 4 November 1971 are presented. Integrated line-intensity ratios are compared with theoretical calculations to obtain a hydrogen density of approximately 10^{10} cm^{-3}. The widths of He I and H I Balmer lines indicate an electron temperature of approximately 7,000 K and a turbulent broadening velocity of approximately 8 km/s for this object. (DE)

30719 SOLAR GRANULATION STATISTICAL ANALYSIS. Aime, C.; Ricort, G. (Nice Univ., 06 (France). Dept. d'Astrophysique). Astron. Astrophys.; 39: No. 2, 319-324(Mar 1975). (In French)

The study of solar granulation brightness fluctuation statistical properties is generally performed by using a scanning spot on the image; either for photoelectric photographic measurement. The measured signal is one dimensional and in order to express the physical meaning of the phenomenon, or to correct instrumental and atmospheric effects, it is necessary to compute the two dimensional power spectrum. The isotropy of the phenomenon allows this study. The computation is generally done by applying the Rogerson (1955) and Uberoi (1955) formulae to the one dimensional P.S., or by computing the Hankel transform of the autocorrelation. Other methods are possible by noting that it is enough to compute two dimensional P. S., along any frequency axis. These are, by presenting advantages and disadvantages of each method, limiting our work to those which only impose precision in the obtaining of data along one direction. (DE)

30720 INTERPLANETARY STREAM MAGNETISM: KINEMATIC EFFECTS. Burlaga, L.F.; Barouch, E. (Laboratory for Extraterrestrial Physics, NASA/Goddard Space Flight Center). Astrophys. J. 203: No. 1, 257-267 (1 Jan 1976).

The particle density, and the magnetic field intensity and direction, are calculated for volume elements of the solar wind as a function of the initial magnetic field direction, Φ_0, and the initial speed gradient, $(\partial V/\partial R)_0$. It is assumed that the velocity is constant and radial. These assumptions are approximately valid between ~0.1 and 1.0 AU for many streams. Time profiles of n, B, and V are calculated for corotating streams, neglecting effects of pressure gradients. The compression and rarefaction of B depend sensitively on Φ_0. By averaging over a typical stream, it is found that $\langle B_r \rangle \sim r^{-2}$, whereas $\langle B_\phi \rangle$ does not vary in a simple way, consistent with deep space observations. Changes of field direction may be very large, depending on the initial angle; but when the initial angle at 0.1 Au is such that the base of the field line corotates with the Sun, the spiral angle is the preferred direction at 1 AU. The theory is also applicable to nonstationary flows. (auth)

30721 INVESTIGATION OF FORBIDDEN TRANSITIONS IN ARGON IONS. Jalufka, N.W. (NASA, Langley Research Center). Astrophys. J. 203: No. 1, 279-283 (1 Jan 1976).

An attempt has been made to observe the visible forbidden argon coronal lines at 553.6 nm (Ar X), 691.7 nm (Ar XI), 847.6 nm (Ar XIII), 441.2 nm (Ar XIV) in a deuterium-argon plasma produced in a large theta pinch. The electron temperature (250 eV) and the electron density (5×10^{16} cm^{-3}) were measured by Thomson scattering of ruby laser radiation. This temperature is adequate to produce ionization stages up to Ar XIV, as was verified by photographic observation of Ar XIV lines. No line corresponding to the coronal lines was observed from the high-temperature plasma, but lines with wavelengths very nearly identical to those of two of the forbidden transitions were observed, and were due to allowed transitions of Ar II in a cooler portion of the plasma. Calculation of rate coefficients in the Coulomb-Born approximation shows that for laboratory experiments electron collisions are much more important than radiative decay in depopulating the upper state of the forbidden lines. (auth)

30722 THE RADIAL VARIATION OF SOLAR FLARE PROTON ANISOTROPIES OBSERVED IN DEEP SPACE ON PIONEERS 10 AND 11. McCarthy, J.; O'Gallagher, J.J. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland (USA) 20742). Geophys. Res. Lett. 3: No. 2, 53-56 (Feb 1976).

The anisotropy of solar flare protons (>3 MeV) evaluated at the time of maximum for each of 24 events measured by the University of Chicago experiments on Pioneers 10 and 11 is observed to decrease gradually between 1 and 4.7 a.u. Since diffusive streaming is related directly to the effective diffusion coefficient parallel to the interplanetary spiral magnetic field ($K_\parallel$), these observations provide a measure of the radial dependence of interplanetary diffusion parameters. An analysis of these results suggests that $K_\parallel$ increases gradually with r consistent with a radial dependence given by $K_\parallel(r) = (8 \pm 3) \times 10^{21}$ cm^2/sec $r^{0.9 \pm .4}$(r in a.u.). (auth)

30723 EFFECT OF SOLAR ACTIVITY ON THE FREE OSCILLATION OF A TORSION PENDULUM. Kolesnikova, E. M.; Kolesnikov, S. M. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 160-171(1975). (In Russian).

30724 BROAD-BAND CIRCULAR POLARIZATION OF SUNSPOTS: SPECTRAL DEPENDENCE AND THEORY. Illing, R. M. E.; Landman, D. A.; Mickey, D. L. (Hawaii Univ., Honolulu (USA). Inst. for Astronomy). Astron. Astrophys.; 41: 183-185 (1975).

Observations of circular polarization in sunspots in two spectral bands are presented; the two distinct regions of polarization recognized in previous work (uniform and "speckled" spatial dependence) are shown to have different spectral dependences. A simple model is advanced which results in circular polarization of the correct magnitude. The implications of the model for the mass flow and magnetic field structure of sunspots are discussed in the light of our previous observations. (DE)

30725 A UNIFIED EXPLANATION OF SOLAR TYPE IV DM CONTINUA AND ZEBRA PATTERNS. Kuijpers, J. (Rijksuniversiteit Utrecht (Netherlands). Sterrekundig Instituut). Astron. Astrophys.; 40: 405-410(1975).

Both type IV dm continuum radiation and zebra patterns can have their origin in plasma waves at the upper hybrid frequency, which are excited by a loss-cone distribution of fast electrons superposed on the thermal background. If the inverse fractional density of fast electrons surpasses the ratio of the electron plasma frequency to the electron cyclotron frequency, instability only exists at those places in the corona where this ratio is integer, thus giving rise to zebra patterns. Some observations in favor of the present explanation are discussed. Upper limits to the magnetic field strength and the fast particle density in the source are derived from the observations. (DE)

30726 SOLAR SUPERGRANULATION. Worden, S. P. Tucson, AR; Univ. of Arizona (1975). 168p. University Microfilms Order No. 75-19,576.

Thesis (Ph. D.).

Supergranulation is a horizontally outflowing pattern of gas on the solar surface. It has subsequently been interpreted as a convective process originating some 10,000 km below the solar surface. As a convective phenomenon supergranulation is believed to play an important role in the generation, distribution, and dissipation of solar magnetic fields. Several observations designed to study these processes are presented. An alternate approach in understanding stellar convection is the study of the dMe stars; a class of late spectral-type dwarf stars which exhibit characteristics

qualitatively similar to solar magnetic activity. An observational test of this hypothesis is presented. Concluding this work a discussion of these observational results within the framework of solar and stellar convection zone-magnetic interactions is provided. (Diss. Abstr. Int., B)

30727 INTERPLANETARY PROPAGATION OF LOW ENERGY SOLAR FLARE PARTICLES. Venkatarangan, P. Alberta; Calgary Univ. (1972). 184p. INIS.

Thesis.

The intensity versus time profiles for protons, alpha particles and medium nuclei (C, N, O and Ne), and the temporal changes in the ratios of protons to alpha particles and alpha particles to medium nuclei for the major solar particle events of November 18, 1968; February 25, 1969 and March 30, 1969 are presented. The ratio of protons to alpha particles is seen to change by a factor as large as 6 within an event, the maximum observed ratio being 100, and that of alpha particles to medium nuclei by a factor as large as 5, the maximum observed ratio being ~25. The propagation of protons of energy $\gtrsim 55$ MeV is adequately explained by the isotropic diffusion model invoked by Parker and Krimigis. However, the propagation of low energy solar flare particles in general is not diffusion-like. The effects of convection of the expanding solar wind on solar flare particles and the resulting energy loss during propagation is examined. It is shown that the variations in the ratio of charged particles of the same rigidity do result as a consequence of energy loss during propagation. The changes in the ratio are derived for assumed forms of source spectrum and energy loss. When the energy loss is proportional to the initial kinetic energy of the particle, the source spectrum is merely shifted without change in its shape or spectral index. Changes in the spectral shape and the bending over at lower energies are seen to occur for other forms of energy loss. (auth)

30728 THE RADIO SUN. Bhonsle, R. V. (Physical Research Lab., Ahmedabad (India)). Phys. News; 5: No. 4, 133-139(Dec 1974).

Current state of knowledge on solar phenomena investigated using ground-based and space-borne radioastronomy techniques are reported. Solar radioemissions are divided into three distinct components: (1) the quiet radiosun, (2) the slowly varying radiosun and (3) the active radiosun. The variations in the intensity of the radio emissions with the three types of activities in the sun are discussed. Solar radiobursts have been classified according to their spectral and temporal characteristics. These characteristics of the bursts (type I and type II) are discussed in terms of the plasma oscillations and instability. The radioheliograph at Culgoora, Australia, the most sophisticated instrument at present for high angular resolution studies, is described. Wavelengths which were not accessible to study in the earth's atmosphere owing to the absorption by the ionosphere are recently being investigated in satellites flown above the ionosphere. Type III bursts have been detected from satellite observations in the range 10 MHz to 0.7 MHz. However, a decisive theory in the understanding of solar flares is still lacking. (AK)

30729 ANNIHILATION OF MAGNETIC FIELDS AND ACCELERATION OF PARTICLES IN SOLAR FLARES. Pikel'ner, S.B.; Tsytovich, V.N. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 19: No. 4, 450-457 (July 1975).

The process of annihilation of a field in the neutral layer is considered with respect to ion-sound turbulence generation. The lower limit of the field inflow velocity is about 10^6 cm·sec^{-1}. An increase in the power of the flare indicates decreasing layer thickness. The thickness depends on the rate of gas evacuation from the layer. It is shown that laminar gas flow along the layer due to the effect of magnetic forces is insufficient for explaining flares. Evacuation occurs as a result of ejections from the layer that appear due to the reconstructed instability of gas restrained by the field. The presence of a weak field in the high-temperature gas does not halt the ejection since the field in the turbulent medium subsequently reconnects and detaches from the layer. The initial disturbances of the boundary and densities within the layer are necessary for the formation of ejections. The mean outflow velocity can reach 0.1 v_a, which ensures high power to the flash phase of the flares. An increase in ejections during the flash phase may result from disturbances due to the development of a tearing instability within the layer or due to the transformation of Langmuir turbulence into strong turbulence associated with the development of modulational instability. Modulational instability pumps the Langmuir waves from the region of low k, where they are unable to accelerate particles, into a region where the waves diverge in accelerating high velocity particles. If the number of such particles is small the waves fit within the tail of a Maxwellian distribution and yield preliminary acceleration. Thus the acceleration process is self-regulated and the total energy of the waves, i.e. up to 10% of the dissipating energy during the flashes, transforms into the energy of the accelerated particles. The spectrum of the particles depends on the loss mechanism (in this case escape) and on the turbulence spectrum. In the quiet phase turbulence is weak, so that acceleration efficiency is low and dissipation results in gas heating to the temperature of several keV. Acceleration of protons by Langmuir waves requires considerable preliminary acceleration. This acceleration occurs by means of Landau damping of ion-sound turbulence and attains the velocity of Langmuir waves only in the most powerful flares. (auth)

30730 GAS-DYNAMIC MODELS OF SOLAR FLARES. Kostyuk, N.D. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 19: No. 4, 458-463 (July 1975).

It is assumed that a flux of electrons with spectrum $E_0^{-\delta}(E_0 \geq 10$ keV) falls from the corona into the chromosphere for 100 sec. Temperature, velocity, density, and ionization distribution are calculated, taking into account gas viscosity at $\delta = 3$, 4, 5, and 6 and for every δ for the four values of the particle energy flux F_0 of $4 \cdot 10^9$, 10^{10}, 10^{11}, and 10^{12} erg·cm^{-2}·sec^{-1} at the heating and cooling stages in open and closed models of the flare region. Basic conclusions previously made that made use of fewer computations are confirmed. The introduction of viscosity permits us to obtain in an explicit form heating of the gas by a shock wave and to consider the effect of high energy fluxes. The distinctive features of heating and cooling in a closed model, corresponding to the structure of an arc-type magnetic field whose ends issue from in the photosphere, are derived. A wide variety of the values of the parameters that characterize the physical conditions in the flare region is obtained. (auth)

30731 THE SOLAR CORONA ON JUNE 30, 1973. Jacoub, S.A.; Nevskii, M.Y.; Leushin, V.V.; Lebedeva, L.N. (National Committee on Scientific Research, Sudanese Democratic Republic). Sov. Astron.—AJ 19: No. 4, 473-476 (July 1975).

The results of the observation of the total solar eclipse of June 30, 1973 in Sudan are presented. The contact times in the band of the total phase of the eclipse are determined. A figure of the coronal structure is discussed. Isophotes of the corona are obtained in three colors and the brightness gradient and flattening of the corona are determined. (auth)

30732 JOINT SOVIET-FRENCH STUDIES OF THE SOLAR CORONA. I. STRUCTURAL PROPERTIES AND PHOTOMETRY OF SOLAR CORONA OF JULY 10, 1972. Vsekhsvyatskii, S.K.; Dzyubenko, N.I.; Nesmyanovich, A.T.; Popov, O.S.; Koutchmy, S. (Kiev State University). Sov. Astron.—AJ 19: No. 4, 477-480 (July 1975).

The results of a study of eclipse negatives obtained on July 10, 1972 by the expedition of the Department of Astronomy of Kiev University through the program of the Soviet-French experiment "Dynamics of the white corona" are presented. Along with the usual details of coronal structure—polar ray systems, large coronal rays, arch systems—new formations are found: "voids" and a sharp boundary. A large number of extended thin jets are noted in the southwest quadrant, as well as a helical ray above a bright condensation, similar to that discovered by Nesmyanovich *et al.* The photometry of one of the negatives showed the considerable heterogeneity of the corona. The mean brightness of the K-corona corresponds to the brightness of the maximum corona in the interval $\rho < 2R_\odot$ according to van de Hulst's model. Coronal holes are noted near the north pole and in the southeast. (auth)

30733 ON THE DIFFERENTIAL ROTATION OF THE SUN AND ITS CYCLES OF ACTIVITY. Iroshnikov, R.S. (P. K. Shternberg State Astronomical Institute). Sov. Astron.—AJ 19: No. 4, 481-487 (July 1975).

The size of convection cells is comparable with the thickness of the convection zone. Therefore the Navier-Stokes or Wasytinsky equations cannot be used to solve the problem of the differential rotation of the convection zone: one must necessarily allow for the distortion by rotation of the field of random velocities. A basis is given for the admissibility of a system of equations which we proposed earlier for the solution of the problem. Solutions are obtained for a thin (compared with the radius) convection zone which show that the equatorial zone rotates faster than the polar zones at all depths. It is shown that the depth dependence of the parameters of the convection zone has a weak effect on the differential nature of the rotation. The parameters of the convection zone and the power and direction of the meridional circulation are estimated. The problem of the generation of a magnetic field is discussed in connection with the estimates made for the parameters of the convection zone. (auth)

30734 STUDY OF AMPLITUDE OF PHOTOSPHERIC VELOCITY FIELD BASED ON WEAK FRAUNHOFER LINES OF METALS. Gurtovenko, É.A. (Main Astronomical Observatory, Academy of Sciences of the Ukranian SSR). Sov. Astron.—AJ 19: No. 4, 488-491 (July 1975).

The radial and tangential components of the photospheric velocity field in the range of geometrical depths -400 km $< h < +50$ km are derived through the analysis of the profiles of 21 weak metal lines by the trial and error method. The main features of this velocity field are: 1) the anisotropy; 2) the increase in both the radial and tangential components with depth; 3) the presence of a maximum in the tangential velocities (3.5 km/sec) at the depth $\tau_5 \simeq 0.2$ and of a maximum in the

radial velocities (2.9 km/sec) at the depth $\tau_5 \simeq 0.5$; a slow decrease in both components in the region of greater optical depths; 4) the tangential component predominates in magnitude; on the average $V^{tg} = 1.5 V^{rad}$. (auth)

30735 INFLUX OF STRATOSPHERIC AIR INTO THE LOWER TROPOSPHERE INCREASED AFTER SOLAR Hα FLARES, X RAY FLARES, AND AFTER PASSAGES OF SOLAR MAGNETIC SECTOR STRUCTURE BOUNDARIES. Reiter, R. (Institut fuer Atmosphaerische Umweltforschung, Garmisch-Partenkirchen, Ger.). Arch. Meteorol., Geophys. Bioklimatol., Ser. A; No. 24, 147-162 (1975).

A previous, tentative study of the question whether solar events will increase the frequency of influxes of stratospheric air into the lower troposphere, was corroborated by considerable augmentation of the data. It has now been established significantly for the period from late 1969 through 1972, that the frequency of injections of stratospheric air will multiply after H_α and x-ray flares, and also after passages of solar magnetic sector boundaries. Additionally, during periods of several months' duration, with increased solar activity, a relation to the relative sunspot number was demonstrated. It thus appears obvious that one must look to certain solar events for the main triggering process causing injections of stratospheric air. Although the causality structure involved is not cleared up as yet, prognostic application of the finding is nevertheless possible. (auth)

30736 VELOCITY FIELDS AND THE RADIATIVE EXCITATION OF ATOMS IN THE SOLAR CHROMOSPHERE. Cuny, Y. (Observatoire de Paris, Section de Meudon, 92 (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 5, 117-120(4 Aug 1975). (In French).

In the solar chromosphere, absorption line profiles are broadened and shifted by microturbulence and macroturbulence respectively, so that photospheric radiation produces strong excitation of atoms. The case of ionized titanium is studied. The computed velocity field effects are in agreement with the solar eclipse data, with regard to the order of magnitude of the effect as well its weak dependence on multiplet. (FR)

30737 SOLAR BRIGHTNESS TEMPERATURE DISTRIBUTION AT 350 AND 450 MICRONS. Righini, G.; Simon, M. (Department of Earth and Space Sciences, State University of New York at Stony Brook). Astrophys. J. Lett. 203: No. 2, L95-L97 (15 Jan 1976).

Solar scans, passband limited to effective wavelengths 350 and 450 μ, have been obtained with angular resolution of about 1'. The observations show little evidence of the limb brightening that would be expected from spherically symmetric homogeneous atmospheric models and the observed increase in brightness temperature in the regions above the solar atmosphere temperature minimum. The observations suggest that the complex structure that is observed at higher levels in the solar atmosphere extends down to the level of the temperature minimum. (auth)

30738 STRUCTURE OF THE SOLAR CHROMOSPHERE. II. THE UNDERLYING PHOTOSPHERE AND TEMPERATURE-MINIMUM REGION. Vernazza, J.E.; Avrett, E.H.; Loeser, R. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. Suppl. Ser. 30: No. 1, 1-60 (Jan 1976).

We present a non-LTE empirical model of the quiet solar photosphere and the temperature-minimum region. The continuous spectrum computed from this model is in good over-all agreement with available disk-center observations throughout the wavelength range 0.125–500 μ. We find that (1) absolute-intensity measurements are needed in the range 1–2 μ to establish the structure of the deepest observable layers; (2) absolute-intensity or flux measurements are needed in the range 20–200 μ to determine whether the minimum solar temperature, occurring between the photosphere and the chromosphere, is as low ($\lesssim$ 4150 K) as indicated by present observations, or much higher ($\gtrsim$ 4450 K, as recent theoretical predictions indicate; (3) studies of the far-ultraviolet spectrum based on the assumption of LTE can be substantially in error; and (4) line opacity seems to account for the "missing opacity" in the ultraviolet. (auth)

30739 FORMATION OF SPECTRAL LINES WITH PARTIAL FREQUENCY REDISTRIBUTION. Heasley, J.N. (High Altitude Observatory, National Center for Atmospheric Research); Kneer, F. Astrophys. J. 203: No. 3, 660-666 (1 Feb 1976).

We present a method for treating the effects of partial frequency redistribution in non-LTE transfer problems. This formulation is appropriate to spectral lines arising from sharp lower levels. Numerical examples of the solar Lα and Ca II K line profiles are presented and compared with the profiles obtained by Milkey and his collaborators. (auth)

30740 A TWO-REGION MODEL OF THE SOLAR WIND INCLUDING AZIMUTHAL VELOCITY. Acuna, M.H. (Laboratory for Extraterrestrial Physics, NASA-Goddard Space Flight Center); Whang, Y.C. Astrophys. J. 203: No. 3, 720-738 (1 Feb 1976).

The two-region model of the solar wind divides the interplanetary space into two regions: it assumes that the solar wind is one-fluid in an inner region $r < 0.4$ AU and two-fluid in an outer region $r > 0.4$ AU. This paper includes the angular motion of the solar wind in the two-region model. The flow in the one-fluid region is governed by the one-fluid magnetohydrodynamic equations. The second and third moment equations of the Vlasov equation together with other conservation equations are used to describe the solar-wind flow in the two-fluid region. The predicted azimuthal velocity at 1 AU is less than 2 km s^{-1}. All other macroscopic and microscopic properties from this model are in good agreement with experimental quiet-time observations at 1 AU. The numerical results also confirm that when the azimuthal velocity is included in the analysis, the amount of magnetic-field energy converted into kinetic energy in the solar wind is only a small fraction of the total expansion energy flux and has little effect upon the final radial expansion velocity. (auth)

30741 SOLAR LIMB BRIGHTENING IN SUBMILLIMETER WAVELENGTHS. Lindsey, C.; Hudson, H.S. (Department of Physics, University of California, San Diego). Astrophys. J. 203: No. 3, 753-759 (1 Feb 1976).

Differential two-beam scans of the Sun in submillimeter wavelengths (350 μ–1 millimeter), made with the UCSD-University of Minnesota 1.5 m telescope at Mount Lemmon, indicate limb brightening approaching 1 percent at $\mu = 0.6$. The observations also show considerable chromospheric structure, both in active and quiet regions, but with less relative amplitude than at millimeter and centimeter wavelengths. The limited angular resolution of our system (about 2' FWHM), together with photometric errors due to fluctuating atmospheric transparency, make the brightness profile of the extreme limb uncertain. The observed degree of limb brightening is considerably less than that consistent with spherically symmetric model atmospheres based on continuum brightness-temperature measurements. The suppression of limb brightening suggests the existence of irregular granular structure with both horizontal and vertical characteristic sizes of order 1500 km. High-resolution images in the wings of the K-line show granular structure of about this horizontal scale. (auth)

30742 SOLAR GAMMA-RAY LINES AS PROBES OF ACCELERATED PARTICLE DIRECTIONALITIES IN FLARES. Ramaty, R.; Crannell, C.J. (NASA/Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. 203: No. 3, 766-768 (1 Feb 1976).

Anisotropies of charged particles accelerated in solar flares can be studied by observing Doppler shifts of selected γ-ray lines. We have calculated the spectral shape of the 6.1 MeV line of ^{16}O. If the accelerated particles are isotropic, the line remains centered at $E_0 = 6129.4$ keV, and its width (FWHM) is about 100 keV. However, for particle anisotropies that may be produced in solar flares, the line is shifted to lower energies by about 30 to 40 keV. (auth)

30743 THE FLUX OF ALFVÉN WAVES IN SUNSPOTS. Beckers, J.M. (Sacramento Peak Observatory, Air Force Cambridge Research Laboratories). Astrophys. J. 203: No. 3, 739-752 (1 Feb 1976).

Under the assumption that the horizontal velocities observed in the sunspot photosphere are caused by Alfvén waves, I derive the flux of these waves in the photosphere to be equal to 20–50 percent of the missing sunspot flux or 2–3 times the spot's flux of electromagnetic radiation. Since the downward-moving Alfvén wave flux is likely to be similar to the upward-moving flux, this observation is consistent with the hypothesis that spots are cooled by their strong emission of Alfvén waves. (auth)

30744 EMPIRICAL STUDY OF CHROMOSPHERIC FINE STRUCTURE BASED ON SIMULTANEOUS SPECTROGRAMS IN THE H, K, 8498 A AND 8542 A LINES OF CA II. Brown, D. R. Boulder, CO; Univ. of Colorado (1974). 346p. University Microfilms Order No. 76-3889.

Thesis (Ph. D.).

High resolution spectrograms were obtained with the Vacuum Tower Telescope at Sacramento Peak Solar Observatory in the H/sub alpha/ line, NaI D lines, CaII K, H, 8498 A and 8542 A lines in absolute simultaneity, as well as K line and continuum slit jaw images. The data includes quite and plage regions near disk center, and quiet center to limb sequences. Spatial resolution ranged between 0.5 and 1.5 arc seconds. From this data, two sets of CaII spectrograms were selected from the quiet sun and plage time sequences and the fine structure profiles identified using the K index. Statistical and visual methods are used to define 4 plage and 6 quiet sun fine structure classes. All K line profiles were doubly peaked and showed little or no variation in the K_1 intensities. The plage data confirms the absence of large scale (greater than or equal to 0.5 arc second) macrovelocity fields in plage, but the Strong Plage fine structure implies either an unresolved

macrovelocity field or a wave broadening mechanism may be operating in those structures. Plage structures exhibit less variation with height than do quiet fine structures. The quiet sun shows mass motions in all structures, with the sign of the velocity maintained between the K_3 and 8542 line core formation heights. Evidence is presented which implies an association between bright rising and/or dark falling elements in the quiet CaII lines. The VP-2 structures show red shifts in all the CaII lines of about 5 km/sec, and the $I(K_3)/I(H_3)$ ratios are consistent with these structures having a depressed temperature gradient at the K_3 formation heights. The K_3 shifts are shown to be true Doppler shifts and that the emission asymmetry in the K line is associated with these shifts. Evidence is presented which shows possible coupling between the K line and 8542 line source functions and velocity shifts. (Diss. Abstr. Int., B)

30745 SOLAR ABUNDANCE OF IRIDIUM. Drake, S.; Aller, L. H. (Univ. of California, Los Angeles). Proc. Natl. Acad. Sci. U. S. A.; 73: No. 2, 269-270(Feb 1976).

By a method of spectrum synthesis, which yields log gfA, where g is the statistical weight of the lower level, f is the oscillator strength, and A is the abundance, an attempt is made to deduce the solar iridium abundance from one relatively unblended, but fairly weak IrI line, lambda 3220.78 A. If the Corliss-Bozman f-value for this line is adopted, we find log A(Ir) equals 0.82 on the scale log A(H) equals 12.00. The discordance with the value found from carbonaceous chondrites may arise from faulty f-values or from difficulties arising from line blending in this far ultraviolet domain of the solar spectrum. (auth)

30746 GENERAL THEORY OF SUNSPOT STATISTICS ON A ROTATING SUN. Kopecky, M. (Astronomical Inst. of the Czechoslovak Academy of Sciences, Ondfejov); Suda, J.; Markova, E. Bull. Astron. Inst. Czech.; 27: No. 2, 65-71(1976).

General statistical relations, valid for sunspot groups on a rotating sun, are derived under the assumption that both fundamental parameters (the number of sunspots originated per unit time over unit heliographic longitude and their frequency distribution with respect to lifetime) depend on time as well as on heliographic longitude. (auth)

30747 RECURRENCES IN THE MAGNETIC FIELD DISTRIBUTION DURING THE PRESENT CYCLE OF SOLAR ACTIVITY. Bumba, V. (Astronomical Inst. of the Czechoslovak Academy of Sciences, Ondfejov). Bull. Astron. Inst. Czech.; 27: No. 2, 74-76(1976).

Some results of a preliminary investigation of Mt. Wilson magnetic synoptic charts obtained during the present activity cycle are presented: in this cycle of activity practically no changes in the behavior of the magnetic field distribution, when compared with the preceding cycle, are observed. Even the roles of the positive and negative polarities seem to remain unexchanged, although their functions of leading and following polarity are exchanged. The importance of the two main recurrences or successions in the large-scale magnetic field distribution with the 27 day and 28-29 day synodic periods of rotation, is emphasized once more. The shifts or "oscillations" of activity in heliographic latitude are mentioned. (auth)

30748 CHARACTERISTIC FIGURES OF SOLAR X-RAY PLAGES. Kleczek, J.; Ruzickova-Topolova, B. (Astronomical Inst. of the Czechoslovak Academy of Sciences, Ondfejov). Bull. Astron. Inst. Czech.; 27: No. 2, 77-83(1976).

Properties of X-ray plages are deduced from 9.1-10.5 Å spectroheliograms. Several characteristic figures are introduced, such as the area A_x, the total flux F_x, the maximum brightness $f_{max}$and the mean gradient of intensity, grad I. The characteristic figures for the X-ray plages are then related to the underlying spot groups and to the corresponding radio plages on λ 9.1 cm. In general, the radio and X-ray characteristics are well correlated. (auth)

30749 RAPID OSCILLATIONS OF THE SOLAR ROTATION. Chistyakov, V. F. (Far-Eastern Scientific Center, Moscow). Bull. Astron. Inst. Czech.; 27: No. 2, 84-91(1976).

The photoheliograms from the years 1955-1963 and 1965-1973 were used for this investigation. The motion of the sunspots was studied. The following facts have been established: the mean law of the solar rotation during 11 years described by the Faye formula $\zeta(\varphi) = a - b \sin^2 \varphi$ is equal for the north and south hemispheres; the form of the law of the solar rotation changes from year to year; coefficients a and b are proportional to each other; the variation of the b coefficients for the northern and southern hemisphere is antiparallel; the rapid oscillations of the solar rotation are accompanied by global meridional motions in the direction of that hemisphere where the rotation velocity is smaller; these peculiarities of the rotation show that torsional oscillations exist on the Sun. The extraordinary motions of the sunspots in the second half of 1972 are described. It was assumed that the central regions of the Sun are unstable. (auth)

30750 RADIOBURSTS IN THE CENTIMETER RANGE AS FORERUNNERS OF PROTON FLARES. Belovskii, M. N.; Nazarova, M. N.; Pereyaslova, N. K.; Frolov, S. G. (Inst. of Applied Geophysics, Moscow). Dokl. Akad. Nauk SSSR; 222: No. 3, 594-595(21 May 1975). (In Russian).

Time variations were investigated in the total number of radiobursts per day in the wavelength range from 1.25 cm to 10 cm in the period from 1969 to Aug. 12th, 1972 by using published data on radio observations at fixed frequencies. It was found that there are periods where the number of radiobursts considerably exceeds a certain background level in the number of radiobursts per day. A total of 58 cases of a definite increase in the number of radiobursts were observed for the period of time under consideration. Simultaneous consideration of sunspot activity showed that the periods of an increase in the number of radiobursts in almost all cases coincide in time with the passage of a number of active solar sunspots. In cases of the simultaneous existence of a number of sunspots the increase in the number of radiobursts is mainly connected with one definite sunspot. In 34 active regions out of 58 which are accompanied by an increase in the number of radiobursts in the centimeter range, one or a number of radiobursts took place in which protons were injected having an energy greater than 10 MeV and a particle flux greater than 10 cm^{-2} sec^{-1}, as counted in cosmic space near the earth. Thus an increase in the radioburst activity of the sun in all probability may be manifested as a sign of the presence of a "proton" flare on the sun. It can be concluded that in active sunspots which are accompanied by an increase in the number of radiobursts in the centimeter range, the probability of appearance of a proton flare is about 60% from observations of the visible side of the sun. Radioburst activity is useful in predicting proton flares. (SJR)

30751 SOLAR X-RAY BURSTS IN RELATION TO THE MICROWAVE BURSTS AND SIDS. Mitra, R. K.; Sarkar, S. K.; Das Gupta, M. K. (Univ. of Calcutta). Indian J. Radio Space Phys.; 4: No. 1, 24-28(Mar 1975).

Solar X-ray bursts recorded by Explorer 37 satellite in the bands 0.5-3, 1-8 and 8-20 Å have been analyzed in relation to their morphological types and peak time attainment at the different wavelength bands. They have also been examined in relation to solar microwave bursts recorded at different frequencies by Sagamore Hill and Manila solar radio observatories and sudden ionospheric disturbances recorded all over the globe. It has been found from both statistical analysis and actual time profile of X-ray bursts that they are mainly of three different morphological types, namely, impulsive, gradual rise and fall (grf) and gradual rise and quick fall (grqf) in contrast to their earlier classification into two types only. Impulsive X-ray bursts were found to be more associated with bright H_α-flares and also with different microwave bursts and SIDs, in comparison to those for the "grf" and "grqf" types of X-ray bursts. The peak of the X-ray bursts at a shorter wavelength is attained in most of the cases earlier than that at a longer wavelength, in general, and this time separation ($+\Delta t$) is more prominent with increasing difference between the bands of the X-rays. X-ray bursts having small Δts are more associated with bright H_α-flares, while bursts with large Δts are found to be more associated with H_α-flares having large durations. It has further been observed that the association of the X-ray bursts, in general, with SIDs in the presence of microwave bursts is about double in comparison to that in the absence of microwave bursts. (auth)

30752 VELOCITIES OF TYPE II SOLAR RADIO BURSTS. Tlamicha, A.; Karlicky, M. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 27: No. 1, 6-10(1976).

A summary is given of type II radio bursts identified at Ondřejov between January 1973 and December 1974 in the frequency range of the dynamic spectrum 70-810 MHz. The velocities of shock waves in the individual cases of the type II bursts are given using the fourfold Newkirk model. Some questions associated with type II radio bursts and with the propagation of the shock wave into interplanetary space and into the region of the Earth are also discussed. (auth)

30753 PRESENCE OF Ar AND In IN THE SOLAR PHOTOMETRIC SPECTRUM. Steyaert, H.; Baeck, N.; Dingens, P. (Rijksuniversiteit, Ghent). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 5, 761-764(1975).

The results obtained with our newly proposed method for analyzing the solar photospheric spectrum are presented for the regions λ 6108.8-λ 6109.42 and λ 6114.76-λ 6115.38. Six new weak lines are found, and the analysis suggests the identification of two lines with In II and one with Ar II. (auth)

30754 DETERMINATION OF HARDNESS OF SOLAR PROTON SPECTRUM FROM THE GEOMAGNETIC CUTOFF ALONG AN EARTH-SATELLITE TRAJECTORY. Shavrin, P. I. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 4, 453-456(1975).

Translated from Kosm. Issled.; 13: No. 4, 503-507(1975).

The incorrectness of employing the vertical hardness $P_\perp = CL^{-2}$ as the effective cutoff hardness P_0 for the determination of the spectrum of flare protons using a total detector on board an artificial earth satellite with an arbitrary trajectory in the geomagnetic field is pointed out. Correction factors are calculated for the conversion from vertical hardness to effective hardness for different values of the coordinates (L, θ) and parameters of the power-law and exponential momentum spectra of solar protons with a dipole approximation of the geomagnetic field. (auth)

30755 SOME FEATURES OF THE STUDY OF CHARGED PARTICLE FLUXES USING TRAPS AND ANALYZERS. III. Determination of Solar Wind Parameters From Energy Spectra. Gurin, L. S.; Zastenker, T. N.; Mokrov, V. S.; Khokhlov, M. Z. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 4, 497-503(1975).

Translated from Kosm. Issled.; 13: No. 4, 555-562(1975).

A method is described for the analysis of energy spectra of ions of the solar wind obtained with the help of a modulation trap. The accuracy in the determination of the velocity of the solar wind, the temperature and concentration of protons, the ratio of concentrations of protons and α particles, and the angle of incidence of the wind on the trap is analyzed on the basis of the model calculations conducted. An example of the determination of these values from the data of the trap on the Prognoz satellite during a strong disturbance in the solar wind on May 15, 1972 is examined. (auth)

30756 HELIOLATITUDE DEPENDENCE OF SOLAR-WIND PARAMETERS. Efimov, A. I.; Lotova, N. A. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 4, 540-542(1975).

Translated from Kosm. Issled.; 13: No. 4, 603-605(1975).

An attempt is made to detect variations in the velocity of the solar wind with heliographic latitude and with the phase of solar activity using measurements obtained with various space vehicles in every year since 1965. (BJG)

30757 DIFFERENCE OF THE MAGNETIC FIELD STRENGTH IN THE SUNSPOT UMBRAE DETERMINED FROM NEUTRAL VANADIUM AND IRON SPECTRAL LINES. Guseinov, M. D. Izv. Krym. Astrofiz. Obs.; 53: 66-74(1975). (In Russian)

The magnetic field strength H was measured in a few sunspots using polarization spectrograms. The values of H determined from the spectral lines of Fe I λ6302.5, V I λ6285.2 and λ6256.9Å are compared. The magnetic field determined from the vanadium lines was found to be stronger by 200 gs than that from the iron line. 27 references. (auth)

30758 PHYSICAL CONDITIONS IN THE FLOCCULI AND THE CHROMOSPHERIC NET. Baranovskii, E. A. Izv. Krym. Astrofiz. Obs.; 53: 75-81(1975). (In Russian)

The temperature and the density are determined in the flocculus on the basis of comparison of the observed and calculated profiles of H_α and K Ca II lines. The theoretical profiles are calculated by means of solving the equations of ionization and statistical equilibrium and radiative transfer with the assumption of noncoherent scattering. It is found that the density in the flocculus ($10^{13}-10^{14}$) is higher and in the region above flocculus ($\sim 10^{10}$) lower as compared to the undisturbed chromosphere. The temperature in the flocculus is found to be 6500–7500°. There is an inversion of electron density. It is shown that the appearance of the chromospheric net can be explained in terms of the two-component chromospheric model, the hot component having higher temperature for the heights h > 1000 km. 13 references. (auth)

30759 DIFFUSION IN THE SOLAR CHROMOSPHERE–CORONA TRANSITION REGION. Tworkowski, A. S. (Dept. of Applied Mathematics and Theoretical Physics, Cambridge, Eng.). Astrophys. Lett.; 17: No. 1, 27-30(1976).

Effects of radial diffusion on local ionization equilibrium in the solar chromosphere–corona transition region are examined. Concentration, thermal, pressure and force diffusion are the forms of diffusion included in the system. A transition region temperature-density model is given which accounts for diffusion and reproduces O VI and Fe IX resonance line intensities consistent with observed values. In all cases considered, ions are pushed by diffusion to higher temperatures, although after 10^6°K some return to their local ionization equilibrium temperature positions. Also, it is found that the element-to-proton abundance density ratio varies with height. (auth)

30760 CHARACTERISTICS OF THE DEVELOPING SPOT GROUPS. Ogir, M. B. Izv. Krym. Astrofiz. Obs.; 53: 82-94 (1975). (In Russian)

The development of the spot groups occurring on the visible solar disk is discussed. The photometric study of H_α-plages has shown that appearance and development of the new spots were accompanied by the noticeable changes in the plage brightness. During the appearance of great number of little spots the lasting strong pulsations occurred side by side with the short ones. The relative brightness can be as high as 3–4. The series of some strong pulsations can be observed with interval between the individual lasting pulsations of approximately 1–1.5 of an hour. The short pulsations take place on the background of the lasting ones. The magnetic field maps has shown that the increasing spot groups can be situated as in isolated magnetic regions. In spot groups, belonging to magnetic complexes, the plage brightenings and flares are often connected with activization of the other regions of this complex. The constancy of the great axe inclination to the parallel is observed in these spot groups. On the other hand, the inclination angle is noticeably changed in groups, situated in isolated magnetic regions. 11 references. (auth)

30761 FEATURES OF THE CHROMOSPHERIC STRUCTURE. Tsap, T. T. Izv. Krym. Astrofiz. Obs.; 53: 95-103(1975). (In Russian)

The fine chromospheric structure in the H_α, H_β, H_γ, H_δ and K Ca II lines is studied. The observations were made with the double spectroheliograph of the Crimean astrophysical observatory. In the H_α line the spectroheliograms are taken at different parts of the line. It is found that there is a good accordance between position of the dark and bright details of the chromospheric fine structure in active and quiet regions. The flocculi brightness maximum is observed in the region of the following polarity in 69% of the cases. 28 references. (auth)

30762 BIRTH AND DEVELOPMENT OF THE ACTIVE REGION AND THE CHROMOSPHERIC NETWORK. Kartashova, L. G. Izv. Krym. Astrofiz. Obs.; 53: 108-115(1975). (In Russian)

The birth and development of 15 active regions was studied on the basis of observations of the H_α line. The studied regions have the simple bipolar configuration with the spots without penumbra. The resolution is 2''. The following conclusions were made: in H_α line center the first young active regions details are formed by means of brightening of the bright fine mottles of chromospheric network. The enhancement and the lengthening of the chromospheric network dark mottles results in the formation of fibril structure. The spots are emerging either between bright fine mottles or close to them from the side of the corresponding network cell center. The spots usually do not emerge between dark fine mottles. In the process of growing of the simple bipolar groups leading and following spots are moving apart together with network cells in which they were born. In the stage of rapid growth around the most active regions, the arcs were observed in the H_α wings. These changes in the chromospheric network are apparently connected with the formation of filament structure around the active regions. 9 references. (auth)

30763 FORECAST OF THE PLAGE ACTIVITY FROM RADIOEMISSION AT λ9.1 cm. Stepanyan, N. N.; Shcherbakova, Z. A. Izv. Krym. Astrofiz. Obs.; 53: 116-120(1975). (In Russian)

To search for the correspondence between the radio brightness temperature at λ9.1 cm near the east limb and the power of the plage appearing the next day at that latitude, the observational data for 1967–1969 were used. The correlation coefficient of these values is found to be 0.84 ± 0.03. The increase of radioemission 1–2 days before the plage birth on the solar disk has been found for 30% of all plages born on the disk. The absence of radioemission 1–2 days before the plage birth on the solar disk is evidence of low future activity of this plage. The correlation coefficient between radioemission on the day of plage birth and its power the next day is found to be R = 0.68 ± 0.07. 10 references. (auth)

30764 TRANSIT OF MERCURY ACROSS THE SOLAR DISK 9 MAY 1970 AND FLUCTUATIONS OF RADIOEMISSION AT λ = 8 mm. Efanov, V. A.; Moiseev, I. G.; Severni, A. G. Izv. Krym. Astrofiz. Obs.; 53: 121-129(1975). (In Russian)

The observations of radioemission at λ = 8 mm of the sun during the transit of Mercury across the disk on 9 May 1970 are described. These fluctuations are attributed to the effect of obscuration of the condensations of radioemission by the disk of the planet. The characteristic sizes of condensations 1''.6–3''.4 and 17''–40'' and brightness temperatures 9420–18250°K are obtained. The larger and cooler condensations correspond to quiet regions while smaller and hotter ones correspond to the active regions. Smaller condensations are of the order of the size of granules and correspond also to the most frequent sizes of inhomogenities of magnetic field. The larger sizes correspond rather to supergranulation cells. It is possible that magnetic field plays important role in formation of condensations of radioemission at λ = 8 mm. (auth)

30765 OBSERVATION OF THE SOLAR ECLIPSE IN CUBA ON THE 24TH OF DECEMBER 1973 AT WAVELENGTH 1.37 m. Yurovskaya, L. I.; Al'vares, O.; Ferreiro, M. Izv. Krym. Astrofiz. Obs.; 53: 130-138(1975). (In Russian)

Following the observation of the solar eclipse on the 24th of December 1973 at wavelength 1.37 m in Habana the structure of the coronal local source has been obtained. The dimension of the source was 3'.0 ± 0'.3 in the uneclipsing direction. The enhanced background continuum region and the burst one were uneclipsed simultaneously. (auth)

30766 INFLUENCE OF SOME FEATURES OF THE SUNSPOT DEVELOPMENT ON THE NOISE STORM RADIOEMISSION. Yurovskaya, L. I. Izv. Krym. Astrofiz. Obs.; 53: 139-143(1975). (In Russian)

The origin of the noise storm sources in the corona more often accompanies fast changes of the spot area and the configuration of magnetic field in the photosphere. It is suggested that the origin of noise storm sources is associated with the unstationary of the magnetic flux penetrating into high levels of the solar atmosphere. (auth)

30767 INVESTIGATION OF MAGNETIC FIELDS OF THE SOLAR FLOCCULI BY RADIO ASTRONOMICAL OBSERVATIONS. Gel'freikh, G. B.; Snegirev, S. D.; Fridman, V. M.; Sheyner, O. A. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 12, 1764-1769(1975). (In Russian)

The weak floccula magnetic field distribution is experimentally measured by the radio astronomical method with a simultaneous measurement of two parameters of the solar radio emission V and $\Delta/$ at one wavelength. In the magnetic field distribution the sections of smooth variations up to 15 Oe are separated which interchange with the sections in which the field has an essential large value (up to 300-600 Oe) and undergo sharp changes up to the change in the polarity. A definite conformity between the obtained distribution and the photosphere magnetic field distribution is observed. (auth)

Galaxies

Refer also to abstracts 30506, 30540, 30542, 30551, 30576, 30584, 30585, 30591, 30604, 30612, 30614, 30636, 30678, 30681, 30682, 30684, 30686, and 30688.

30768 AN INTERPRETATION OF THE RADIO- AND IR-SPECTRUM OF THE COMPACT H II REGIONS W 3(A) AND W 3(OH). Kruegel, E. (Goettingen Univ. (F. R. Germany). Sternwarte); Mezger, P. G. (Max-Planck-Institut fuer Radioastronomie, Bonn (F. R. Germany)). Astron. Astrophys.; 42: 441-448(1975).

Models are fitted to the observed integral characteristics and radio and IR spectra of the compact H II regions. W 3(OH) appears to be ionized by an O-star, which has not yet reached the main sequence. It is surrounded by a compact, dust-depleted H II region. Some distance outside the H II region is a dense shell of gas and dust whose inner radius is between 20 to 40 times the radius of the compact H II region. There does not appear to be a strong density gradient in the ionized gas. W 3(A) is surrounded by a dense, dust-enriched shell of ionized gas which is embedded in a dense cloud of neutral gas and dust. The diameter of the ionized shell is comparable to the diameter of the neutral shell surrounding the compact H II region W 3(OH). The two H II regions appear to represent two different stages in the dynamical evolution of compact H II regions in which dust plays the dominant role. Some characteristics of the dust are obtained. (DE)

30769 BOUNDS FOR THE INTERSTELLAR TO SOLAR SYSTEM MICROPARTICLE FLUX RATIO OVER THE MASS RANGE 10^{-11} TO 10^{-13} g. McDonnell, J. A. M. (Univ. of Kent, Eng.); Berg, O. E. pp 555-563 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

A statistical analysis of the front film and grid coincidence events recorded over 5 years of observation on deep space probes Pioneer 8 and 9 is presented using computer integrated graphs. The data show a predominance of particles towards the probe apex for mass $\sim 10^{-11}$ g in accordance with a "sweeping up" of particles in degraded cometary orbits, but for particles $\sim 10^{-13}$ g a predominance of particles incident from an apparent solar direction is observed. Average omnidirectional, probe apex and "solar" oriented fluxes are presented. The data have been analyzed to investigate the possibility of a component from an interstellar source. Although the analysis indicates a small excess of particles corresponding to celestial directions 240°-360° longitude, which could indicate a celestial component arising from the solar apex of motion, the magnitude of this effect is entirely commensurate with normal statistical variations of the impact rate. A bound on the maximum magnitude of an interstellar component is placed at <4% for particles of mass $\gtrsim 10^{-13}$ g. (auth)

30770 MEASUREMENT OF THE TEMPERATURE OF THE INTERSTELLAR MEDIUM AROUND THE HELIOSPHERE, OBTAINED WITH THE MARS 7 INTERPLANETARY PROBE. Bertaux, J. L. (CNRS, Verrieres-le-Buisson, France); Blamont, J. E.; Tabarie, N.; Dementeva, N. N.; Kurt, V. G.; Smirnov, A. S. pp 721-726 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974).

Results of a Lyman-alpha photometer placed on the interplanetary probe Mars 7 are presented. The Lyman alpha emission linewidth of interplanetary hydrogen was analyzed by means of an absorption hydrogen cell, yielding a temperature of $10^{4\pm}$K for the local neutral interstellar hydrogen, through which the solar system travels with a velocity of $\approx$11 km s^{-1}. (auth)

30771 THERMAL BEHAVIOR OF THE NEUTRAL INTERSTELLAR GAS WITHIN THE SOLAR SYSTEM. Fahr, H. J. (Univ., Bonn). pp 727-731 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116-.

The change of the dynamical and thermal status of interstellar matter that sweeps over the solar system is shown to be adequately described by means of the Boltzmann-Vlasov equation. A solution of this equation is reached by the application of the single particle orbit technique. An explicit form of the velocity distribution function within the solar system is given. This function is shown to be highly anisotropic. It deviates strongly from the initial velocity distribution outside the solar system and permits calculation of mean drift velocities and temperatures. It is obvious that interstellar gas penetrating the solar system is subjected to a pronounced heating that is due to the conversion of kinetic into thermal energy of the gas by the action of the solar gravitational field. Temperatures of up to 10^5 K at 1 AU are represented by the thermal status of the gas. The thermally disturbed region is extended to more than 100 AU in the direction of the interstellar wind. (auth)

30772 HIGH RESOLUTION SURVEY OF THREE HIGH VELOCITY CLOUD COMPLEXES. Davies, R. D. (Univ. of Manchester, Eng.); Buhl, D.; Jafolla, J. Astron. Astrophys., Suppl. Ser.; 23: No. 2, 181-204(Feb 1976).

A survey has been made of the high velocity cloud complexes A IV, M II and C III with high angular resolution and high sensitivity using the NRAO 140 foot and 300 foot radio telescopes. The results are presented in the form of position-velocity diagrams and of maps of the regions at selected velocities. Considerable structure was found in the brighter HVCs having an angular scale of 0.2° to 0.5° and a velocity width of 7 to 20 kms^{-1}. Weaker HVC emission was detected over large areas of the surveys. The structure of the intermediate velocity (IVCs) in these regions was also investigated. The IVCs studied here are significantly larger in angular size and narrower in velocity width than the HVCs. 13 figures (auth)

30773 SPIRAL MODES IN COLD CYLINDRICAL SYSTEMS. Robe, H. (Leige Univ. (Belgium). Inst. d'Astrophysique). Astron. Astrophys.; 39: No. 2, 455-459(Mar 1975).

7 figs.; 1 tab.; 6 refs.

The linearized hydrodynamical equations governing the non-axisymmetric free modes of oscillation of cold cylindrical stellar systems are separated in cylindrical coordinates and solved numerically for two models. Short-wavelength unstable modes corresponding to tight spirals do not exist; but there exists an unstable growing mode which has the form of trailing spirals which are quite open. (DE)

30774 ON THE INTERSTELLAR ABUNDANCE OF SODIUM AND POTASSIUM. Lequeux, J. (Observatoire de Paris, Section de Meudon, 92((France). Dept. de Radioastronomie). Astron. Astrophys.; 39: No. 2, 257-261(Mar 1975).

2 figs.; 3 tabs.; with refs.

The column densities of interstellar neutral sodium and potassium in front of 15 stars for which detailed profiles of the K^0 λ 7,699-line and of the Na^0 D-line exist are described. It is shown that K^0 and Na^0 are distributed in the same way along the line of sight, and if depleted have the same amount of depletion. From the Ca^0/Ca^+ ratios observed in front of 9 of the stars, the electron densities are described to solve the Na^0/Na^+ and K^0/K^+ ioniza-

tion equilibria. The total column densities of Na and K thus obtained imply depletions by factors 3-10, and more for two stars in Scorpius. It is not certain that depletions by factors 3-10 are real: some atomic parameters used in this study may be incorrect; alternatively, it may be that most of the strongly-depleted calcium is in the boundaries of the clouds, which may be more ionized than the central parts where most Na and K are found. (DE)

30775 MODELS OF GALACTIC NUCLEI. de Sabbata, V.; Fortini, P.; Baroni, L. F.; Gualdi, C. (Univ., Bologna). Acta Phys. Pol., Ser. B7: No. 2, 99-116(Feb 1976).

Various models of the galactic nuclei are discussed. The dense star cluster model for the galactic center is treated in greater detail. It turns out that such model can explain many of its observed properties, i. e. emission of gravitational waves, number density and energy of cosmic rays in the Galaxy, γ and x-ray emission, infrared and radio spectrum. (auth)

30776 THE HUBBLE DIAGRAM FOR NUCLEAR MAGNITUDES OF CLUSTER GALAXIES. Weedman, D.W. (Dyer Observatory, Vanderbilt University). Astrophys. J. 203: No. 1, 6-13 (1 Jan 1976).

Luminosities within central diameters of about 5 kpc (defined as the nuclear magnitudes) are given for the 10 brightest galaxies in each of nine rich clusters. Corrections required to use these magnitudes as relative distance indicators are discussed. The resulting Hubble diagram shows no evidence for significant non-Hubble velocities for 1000 km s^{-1} $< CZ <$ 11,000 km s^{-1}. If the mean magnitudes of the five brightest nuclei in each cluster are considered, the σ (Δm) from the mean Hubble line is only 0.15 mag and the σ (Δ log CZ) is 0.029. (auth)

30777 ON ESTIMATING THE UNPROJECTED LUMINOSITY DENSITY WITHIN A CLUSTER OF GALAXIES. Press, W.H. (Joseph Henry Laboratories, Princeton University). Astrophys. J. 203: No. 1, 14-22 (1 Jan 1976).

For an apparently spherical cluster of galaxies, it is desired to estimate the spherical density profile ρ (r) from the positions of individual galaxies projected into the plane of the sky. The classical methods of von Zeipel and Plummer require that the data be smoothed and are sensitive (and unstable) to this smoothing. An alternative method is outlined here: From the observed (projected) positions an integral transform is computed. The transform is then filtered in such a way as to eliminate spurious information due only to the discreteness of the data. Finally, ρ (r) is reconstructed from the filtered transform. Almost any integral transform can be modified to use in this way; detailed formulae are given for the Mellin and Hankel transforms. (auth)

30778 IS THE LOCAL SUPERCLUSTER A PHYSICAL ASSOCIATION? Bahcall, J.N. (Institute for Advanced Study); Joss, P.C. Astrophys. J. 203: No. 1, 23-32 (1 Jan 1976).

The nearby bright galaxies appear to be concentrated toward a particular great circle on the sky. This distribution has been previously interpreted as implying that our Galaxy is a member of a local supercluster. We describe a quantitative measure of the degree of concentration of a sample of galaxies toward any great circle, and we apply this measure to the Shapley-Ames and de Vaucouleurs catalogs of bright galaxies as well as to computer-simulated catalogs of galaxies. We find that the observed distribution can be explained as the combined result of obscuration by our own Galaxy, purely local clustering on angular scales $\lesssim 10°$, and our proximity to a rather large and populous cluster, the Virgo cluster. In order for our interpretation to be correct, the Virgo cluster must have a mean angular radius of the order of or greater than 15°. Our interpretation is supported by recent measurements that do not indicate any large inhomogeneities in the motions of nearby galaxy clusters and that show that the mean recessional velocity of the Virgo cluster is consistent with a uniform Hubble expansion. If our interpretation is correct, it may be possible to determine the Hubble constant directly from measurements of individual distance indicators (such as H II regions and the brightest stars) with distance moduli $\lesssim 32$. Further radial velocity measurements of many nearby galaxies would probably enable one to distinguish between the presently conventional hypothesis of a local supercluster and our suggestion of a moderately large Virgo cluster combined with other selection effects. (auth)

30779 IS THE LOCAL SUPERCLUSTER A RANDOM CLUMPING ACCIDENT?. de Vaucouleurs, G. (Department of Astronomy and McDonald Observatory, The University of Texas). Astrophys. J. 203: No. 1, 33-38 (1 Jan 1976).

The distribution of bright galaxies and nearby groups has been interpreted alternatively as the result of (*a*) a physical association (the local supercluster hypothesis), or (*b*) a statistical accident (the random clumping hypothesis). The latter view, as developed by Bahcall and Joss, rests on a presumed demonstration that the "apparent supercluster effect," as measured by a certain statistical index K, can be reduced to a level compatible with hypothesis (*b*). A critical assessment of the BJ analysis shows that it is faulty in its methodology and that their model is quantitatively untenable in its requirements. This model calls for at least three ad hoc assumptions, some highly artificial; in particular, it leads to an excessive estimate of galactic obscuration and postulates a fictitiously large radius for the Virgo cluster. Independent statistical tests applied to the observed distribution and orientation of nearby galaxies, intergalactic gas clouds, and groups and clouds of galaxies have already confirmed the physical reality of the supergalactic disk and demonstrated the very low probability of the random clumping hypothesis. (auth)

30780 *K*-CORRECTIONS FOR GALAXIES OF DIFFERENT MORPHOLOGICAL TYPES. Pence, W. (Department of Astronomy, University of Texas, Austin). Astrophys. J. 203: No. 1, 39-51 (1 Jan 1976).

Mean energy distributions from 1500 to 8000 Å for different types of galaxies have been derived from satellite ultraviolet filter photometry and from Earth-based spectrum scans. K-corrections for the standard U, B, V filters have been calculated from these energy distributions. The K-corrections are used to calculate the mean redshift, mean observed color, and color distribution of galaxies as a function of apparent magnitude and type in a Euclidean universe assuming no galaxy evolution and no intergalactic extinction. (auth)

30781 EVOLUTIONARY SYNTHESIS OF THE STELLAR POPULATION IN ELLIPTICAL GALAXIES. I. INGREDIENTS, BROAD-BAND COLORS, AND INFRARED FEATURES. Tinsley, B.M. (The University of Texas at Dallas and Austin); Gunn, J.E. Astrophys. J. 203: No. 1, 52-62 (1 Jan 1976).

Broad-band photometric data and infrared line indices have been combined with new results on giant-branch luminosity functions to yield population synthesis for giant elliptical galaxies. If the main-sequence mass function is a power law of slope x, a value $x < 1$ is indicated. This yields rather rapid luminosity evolution and a large correction to the deceleration parameter q_0 as derived from the Hubble diagram for first-ranked cluster ellipticals. The uncertainties are discussed. (auth)

30782 COMPOSITION GRADIENTS ACROSS SPIRAL GALAXIES II. THE STELLAR MASS LIMIT. Shields, G.A. (University of Texas at Austin); Tinsley, B.M. Astrophys. J. 203: No. 1, 66-71 (1 Jan 1976).

The equivalent width of the Hβ emission from H II regions in spiral galaxies increases with distance from the nucleus. We interpret this W (Hβ) gradient in terms of a radial gradient in the temperature of the hottest exciting stars. (T_u). From Searle's observations of M101, we infer an increase Δ log $T_u = 0.02$–0.13 from the intermediate to outermost spiral arms of M101. There is also a radial decrease in the metal abundance (Z) across M101, and the T_u gradient is consistent with the prediction of Kahn's recent theory that the upper mass limit for star formation should be smaller in regions of high Z. We note also that, even in the absence of changes in the upper mass limit, a T_u gradient is expected because metal-rich stars of given mass have smaller effective temperatures. Several observational and theoretical improvements are needed before firm conclusions can be drawn, but it is clear that the presence of a T_u gradient may lead to several important systematic changes in the interpretation of gradients in the properties of H II regions across galaxies. A T_u gradient reduces the Z gradient that is inferred from emission-line ratios, and it may help to explain why [O II] is strong in the innermost regions where [O III] is weak. A T_u gradient may also partly camouflage a helium abundance gradient. (auth)

30783 THE EFFECT OF DYNAMICAL FRICTION ON THE ORBITS OF THE MAGELLANIC CLOUDS. Tremaine, S.D. (Joseph Henry Laboratories, Department of Physics, Princeton University). Astrophys. J. 203: No. 1, 72-74 (1 Jan 1976).

If our Galaxy has an extended, massive halo, then dynamical friction must have caused substantial decay of the orbits of the Magellanic Clouds over the last 10^{10} yr, during which time the Galactic tidal force at perigalacticon must have steadily increased. The present proximity of the Large and Small Clouds can be explained if they were originally a bound system, which was disrupted by tidal forces only at its last, closest perigalacticon. The Large Cloud will be disrupted by the Galaxy in (2–4) $\times 10^9$ yr, increasing the luminosity of the Galaxy by -0.24 mag. (auth)

30784 ON THE MASS OF THE HALO POPULATION. Lucy, L.B. (Departments of Physics and Astronomy, University of Pittsburgh). Astrophys. J. 203: No. 1, 75-80 (1 Jan 1976).

Implications of the hypothesis that the halo is the major contributor to the Galaxy's interior mass ($R < R_0$) are worked out and compared with observation. The required local density of halo stars is found to be $\sim 0.007\, M_\odot$ pc^{-3}, and this is shown to be not inconsistent with the observational data. Eddington's model for spherical stellar systems, in which the velocity distribution is everywhere ellipsoidal, is argued to be an acceptable model for the halo and is used to explore the consequences of the halo being an approximately self-gravitating system.

When the parameters of the model are determined from the observed velocity dispersions of local halo stars, it predicts a mass distribution that corresponds to a rotation curve agreeing closely with the Galaxy's except in the nuclear regions ($R < 1$ kpc). With a truncated velocity distribution, the model is also used to investigate the exterior ($R > R_0$) structure of the halo, and a significant increase in the Galaxy's total mass is found if the total space motions of local halo stars extend to ~ 425 km s^{-1}. (auth)

30785 ON DENSITY WAVES IN GALAXIES. II. THE TURNING-POINT PROBLEM AT THE COROTATION REGION. Mark, J.W. (Massachusetts Institute of Technology). Astrophys. J. 203: No. 1, 81-96 (1 Jan 1976).

A more careful analysis has been made of the galactic density waves near the corotation region where the wave pattern speeds are the same as the local circular speed of the disk. We have removed some ambiguities that occurred in previous solutions due to the assumption of a single wave picture. After certain mathematical transformations were performed, a reduced form of the wave gravitational potential is now found to satisfy a turning-point differential equation. This equation involves two turning points in a manner analogous to those which occur in the quantum-mechanical problem of wave-tunneling through a parabolic potential barrier. As is the case for the quantum-mechanical analog, the improved density wave solutions involve the interaction of several waves near corotation. (auth)

30786 INVERSION OF THE OH 1720-MHz LINE. Elitzur, M. (Department of Nuclear Physics, Weizmann Institute of Science, Rehovot, Israel). Astrophys. J. 203: No. 1, 124-131 (1 Jan 1976).

It is shown that the OH 1720-MHz line can be strongly inverted by collisions which excite the rotation states, preferentially the $^2\pi_{3/2}$ ladder. It is also argued that radiative pumps (of any wavelength) can strongly invert only the 1612-MHz line. Inversion of the 1720-MHz line with $|r| \lesssim 1$ can be achieved by either collisional or radiative pumps at low OH densities ($n_{OH} \lesssim 10^{-3} - 10^{-4}$ cm^{-3}). (auth)

30787 INTERSTELLAR H_2: THE POPULATION OF EXCITED ROTATIONAL STATES AND THE INFRARED RESPONSE TO ULTRAVIOLET RADIATION. Black, J.H.; Dalgarno, A. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. 203: No. 1, 132-142 (1 Jan 1976).

Molecular hydrogen in interstellar clouds absorbs ultraviolet radiation in lines of the Lyman and Werner systems. The subsequent fluorescence leads to dissociation or to the population of excited rotational-vibrational levels of the ground electronic state. The rotational-vibrational levels decay by means of quadrupole transitions which result in the emission of infrared photons and populate excited rotational levels of the lowest vibrational state. An additional input into the cascade is provided by the formation of molecules on grain surfaces. A concise tabular description of the rotation-vibration cascade is presented. Calculations of the infrared emission spectrum of H_2 are given for an illustrative cloud model which includes the processes of fluorescence and hot molecule formation. In favorable circumstances, some of the infrared lines may have detectable intensities. Due to the distribution of lines, it may prove possible to detect interstellar H_2 using narrow-band filter photometry at a wavelength of 2.4 μ. (auth)

30788 FURTHER STUDIES OF IONIZATION IN INTERSTELLAR CLOUDS. Hobbs, L.M. (Yerkes Observatory, University of Chicago). Astrophys. J. 203: No. 1, 143-150 (1 Jan 1976).

Interferometric scans of the interstellar λ7699 line of K I or of the D_1 line of Na I are reported for 14 stars. Along with results obtained recently by others for the column densities N (H I), N (H$_2$), or N (Na I) toward a larger number of stars, these results are added to a previous compilation of such data, and are used to analyze again the relations among the well-correlated quantities N (K I), N (Na I), and N_H. The estimated depletion factors of both K and Na are about 3 to 4. Alternatively, the fractional ionization $n_e/n_H \gtrsim 9 \times 10^{-4}$ in these relatively low-density clouds, if the K and Na abundances are not to exceed their solar values. Photoionization of the heavy elements by starlight can account for the greater part of this ionization, if interstellar carbon is undepleted. The influence of temperature effects and of gas-phase chemical reactions on the approximately quadratic variations of N (K I) and N (Na I) with N_H are discussed. (auth)

30789 OBSERVATIONS OF THE GUM NEBULA WITH A FABRY-PEROT SPECTROMETER. Reynolds, R.J. (Physics Department, University of Wisconsin, Madison). Astrophys. J. 203: No. 1, 151-158 (1 Jan 1976).

Scans have been made of Hα, [N II] λ6584, [O III] λ5007, and He I λ5876 in selected directions in the Gum Nebula. Analyses of the line profiles and line intensities indicate that much of the emitting gas in the Gum Nebula is confined to an expanding shell which has a radius of about 125 pc, an expansion velocity of approximately 20 km s^{-1}, an emission measure which ranges from about 15 cm^{-6} pc to about 500 cm^{-6} pc, and a temperature near 11,000 K. The ultraviolet ($h\nu > 13.6$ eV) flux from ξ Pup and γ^2 Vel appears to be capable of producing most of the observed ionization, although the origin of the shell structure and high expansion velocity is not certain. (auth)

30790 OPTICAL AND MILLIMETER-WAVE OBSERVATIONS OF THE M8 REGION. Lada, C.J. (Center for Astrophysics, Harvard College Observatory); Gull, T.R.; Gottlieb, C.A.; Gottlieb, E.W. Astrophys. J. 203: No. 1, 159-168 (1 Jan 1976).

Millimeter-wave observations made toward the NGC 6530-M8 star-forming complex are compared with high-quality optical interference-filter photographs of that region taken with the new Kitt Peak 4-m Mayall telescope and the Kitt Peak No. 192-cm telescope. Extensive CO observations reveal a large molecular cloud in this direction, within which three bright spots of CO emission are found. Two bright spots are associated in angle with prominent optical features. One of these is coincident with the star Herschel 36 and the well-known Hourglass Nebula, and the second appears coincident in angle with a bright-rimmed structure shown to be an ionization front southeast of Herschel 36. Emission from H_2CO at 140.8 GHZ and H_2O at 22.2 GHz has been detected from this last bright spot but not from the other two. The third bright spot does not seem to be associated with any visible nebular feature. Carbon monoxide, radio continuum, and optical Hα emission are found to be very similar in angular distribution throughout M8. The kinematics of the molecular cloud are studied, and we find that the radial velocity of CO emission varies smoothly across the cloud, but it is difficult to interpret this in terms of coherent mass motion of the entire cloud. Analysis of available radial-velocity data for the H II region shows that the ionized gas is approaching the Earth at a velocity of 7 km s^{-1} with respect to the molecular cloud. Analyses of CO, radio continuum, and, especially, optical data indicate that Herschel 36 is the most likely ionizing source for most of the M8 H II region. Comparison of optical and radio observations suggests a geometrical model for the region, which places the H II region at the front edge of the molecular cloud. Further considerations indicate that the M8 molecular cloud, the M8 H II region, the young cluster NGC 6530, and the Sgr OB1 association appear to be related in a geometrical evolutionary sequence with cloud evolution, and possibly star formation, proceeding inward with time from the position of the foreground star cluster to the position of the molecular cloud. (auth)

30791 DEEP ICE ABSORPTION IN A PECULIAR INFRARED SOURCE. Cohen, M. (Astronomy Department, University of California, Berkeley). Astrophys. J. 203: No. 1, 169-170 (1 Jan 1976).

2-4 μ spectrophotometry with a resolution $\Delta\lambda/\lambda \simeq 0.015$ is presented of an infrared source close to the outer projected edge of the Rosette Nebula. A deep absorption feature is seen, centered near 3.0 μ, and this can be approximated by laboratory data on the extinction due to pure, spherical ice grains. With this identification, the central optical depth of the best-fit ice extinction curve is ~ 2.6, and the column mass of ice is $\sim 2 \times 10^{-4}$ gm cm^{-2}. (auth)

30792 RADIATIVE TRANSFER IN SPHERICAL CIRCUMSTELLAR DUST ENVELOPES. IV. THE INFRARED EMISSIVITY PROFILE AND COMPOSITION OF THE DUST IN NGC 7027. Apruzese, J.P. (Physics and Astronomy Department, University of Wyoming). Astrophys. J. 203: No. 1, 177-181 (1 Jan 1976).

Using radiative transfer methods described in the previous papers of this series, dust-emission models of the bright planetary nebula NGC 7027 have been calculated. An analysis of the infrared continuum of NGC 7027 based upon these calculations shows the following: *a*) If the spatial dust distribution coincides with the ionized gas distribution as given by Scott in 1973 (within $\sim 3.2'$ from the center), the infrared continuum may be produced by an unknown substance whose infrared emissivity declines with increasing wavelength to about 50 μ and then rises. *b*) If there exists a cool outer dust shell beyond $5' - 6'$ from the central source, the observed infrared continuum may be produced by iron grains of radius 1 μ or by a mixture of smaller iron and graphite grains. (auth)

30793 PHENOMENOLOGICAL ANALYSIS OF OBSERVED RELATIONS FOR LOW-REDSHIFT GALAXIES. Nicoll, J. F.; Segal, I. E. (Massachusetts Inst. of Tech., Cambridge). Proc. Natl. Acad. Sci. U.S.A.; 72: No. 12, 4691-4695(Dec 1975).

Maximum-likelihood estimates are made for the exponent p in the phenomenological redshift-distance relation z varies as r/sup p/ for galaxies at redshifts less than or equal to 0.03, on the basis of redshift (z)-magnitude (m)-apparent diameter (theta) observations given in the Reference Catalogue of Bright Galaxies [de Vaucouleurs, G. and de Vaucouleurs, A. (1964)]. The estimates are in the range 1.96 less than or equal to p less than or equal to 2.04 for the full sample of 742 galaxies having m - z - theta data, with dispersions less than or equal to 0.08, and in a similar but broader range for various subsamples. Explicit allowance for an observational cutoff in apparent magnitude in the m - z relation reinforces the result that p is approximately 2. Independent estimation based on a cut-off independent generalized Kafka-Schmidt

V/V/sub m/ test for a subsample in conservatively limited redshift and magnitude ranges yields p equals 2.05. (auth)

30794 THE ORIENTATION OF DOUBLE RADIO SOURCES ASSOCIATED WITH ELLIPTICAL GALAXIES. Gibson, D. M. (Virginia Univ., Charlottesville (USA); National Radio Astronomy Observatory, Charlottesville, Va. (USA)). Astron. Astrophys.; 39: No. 2, 377-382(Mar 1975).

The comparison of the relative orientations of oblate galaxies and their associated double radio sources with a distribution of position angle differences predicted theoretically provides a sensitive test of models in which the ejection has a preferred direction. The sample, chosen such that the standard deviations in the determination of the position angle difference are less than 30°, is comprised of 33 systems from which the following conclusions are drawn. Ejection near the polar axis is almost certainly ruled out. The observed distributions are, however, found to be consistent with random ejection; they are also found to be consistent with planar ejection provided the dispersion about the rotation plane is large (approximately 45°). (DE)

30795 THE COLOR GRADIENT IN SPIRAL GALAXIES: APPLICATION TO M 81. Segalovitz, A. (Rijksuniversiteit Leiden (Netherlands). Sterrewacht). Astron. Astrophys.; 40: 401-404 (1975).

The calculated development of the color of a star cluster is used to predict the expected color evolution, as a function of radius, in a spiral galaxy. It is assumed that the fraction of gas which is converted into stars during a spiral arm passage is a function of radius only. Applying this model to M 81, it is shown that the observed color and mass distributions can be explained by an initial disk-like gas distribution proportional to the inverse square of the radius and a consumption fraction which is an increasing function of radius. (DE)

30796 A NEUTRAL HYDROGEN STUDY OF THE INTEGRAL-SIGN GALAXY MCG 12-7-28. Bottinelli, L.; Gouguenheim, L. (Observatoire de Paris, Section de Meudon, 92 (France). Dept. de Radioastronomie). Astron. Astrophys.; 39: No. 2, 341-343(Mar 1975).

The "integral-sign" galaxy MCG 12-7-28 has been studied in the 21-cm line of neutral hydrogen with the Nancay radio telescope. Its integral properties are consistent with the following results: the galaxy has an Sb or Sbc type, it is located at a distance of about 18 Mpc and it is seen edge-on. (DE)

30797 YOUNG STELLAR CLUSTERS IN DIFFUSE NEBULAE. Glushkov, Yu. I.; Denisyuk, E. K.; Karyagina, Z. V. (AN Kazakhskoj SSR, Alma-Ata. Astrofiziceskij Inst.). Astron. Astrophys.; 39: No. 2, 481-485(Mar 1975).

Some results of spectrophotometric studies of compact H II regions are presented. From optical observations, compact components are found in 13 diffuse nebulae. Values of electron density n_e, absorption—A(Hα) and diameters—d are given for NGC 7538, NGC 6618, S235 AB. Three compact H II regions are observed in NGC 7538. The nebula M 17 or NGC 6618 has six compact components and two older and further expanded components. This nebula is a unique cluster of compact H II regions. Two newly discovered compact H II regions (S235 AB) contain a few condensations with $n_e = 3.1 \times 10^3$ to 10^5 cm^{-3}, A(Hα) = 6.5 to 13^m, 6 and sizes of approximately 0.04 pc. The existence of expanding motions in one condensation ($V_r \geq 100$ km s^{-1}) makes this condensation extremely interesting. It seems that many of the investigated nebulae actually consist of several components each containing a stellar cluster, in different evolutionary stages. (DE)

30798 THE RELATIVE ABUNDANCE OF NITROGEN AND SULPHUR IN THREE SPIRAL GALAXIES: M 33, M 101, M 51. Comte, G. (Observatoire de Marseille, 13 (France); Centre National de la Recherche Scientifique, 13—Marseille (France). Observatoire de Haute Provence). Astron. Astrophys.; 39: No. 2, 197-205(Mar 1975).

Photographic spectrophotometrics are presented of the forbidden lines of [N II] λλ 6,548, 6,584 and [S II] λλ 6,717, 6,731 in H II regions of three galaxies: M 33, M 101 and M 51. Since under normal excitation conditions, these lines are emitted in common volume elements of the interstellar ionized gas, the intensity ratio I([N II])/([S II]), which is practically electron temperature independent and reddening-free, is an indicator of the chemical abundance of nitrogen relative to sulphur. There is evidence for a radial variation of the N/S abundance in M 33 and M 101, which is probably due to a radial gradient in the absolute abundance of nitrogen. On the other hand, no gradient is found across the disk of M 51, whose H II regions seem systematically nitrogen overabundant with respect to H II regions located in the other two galaxies. (DE)

30799 NEBULAR MASS OF PLANETARY NEBULAE. Perinotto, M. (Osservatorio Astrofisico di Arcetri, Florence (Italy)). Astron. Astrophys.; 39: No. 2, 383-391(Mar 1975).

The best available optical and radio information on forty-three planetary nebulae have been used to investigate the problem of the individual determination of the nebular masses. Updated equations, which consider the contribution of helium to the nebular mass and to the number of free electrons, have been employed. The masses derived for the planetary shells range mostly from 10^{-3} to 1M(sun). (DE)

30800 SPECTROSCOPIC OBSERVATIONS OF EXTREMELY COMPACT GALAXIES. Ulrich, M. H. (Texas Univ., Austin (USA). Dept. of Astronomy). Astron. Astrophys.; 40: 337-338 (1975).

Low-dispersion spectrograms have been obtained for 22 galaxies noted as "Extremely Compact" in the Catalogue of Galaxies and of Clusters of Galaxies published by Zwicky and collaborators and radial velocities are given for 14 of them. Ten galaxies have emission lines spectra and one of them (0934 + 01) is a new Seyfert-type galaxy with broad hydrogen lines and narrow forbidden lines. K and H lines at nearly zero velocity are seen on the spectra of two galaxies and presumably originate from galactic stars projected on the galaxy nuclei. (DE)

30801 TIME OF GALAXY FORMATION IN A TURBULENT UNIVERSE. Bonometto, S. A. (Padua Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Padua (Italy)); Danese, L. (Padua Univ. (Italy). Istituto di Astronomia); Lucchin, F. (Padua Univ. (Italy). Istituto di Fisica). Astron. Astrophys.; 41: 55-59(1975).

In the framework of a turbulent theory of galaxy formation, it is shown that the red-shift at which non-linear effects may become relevant on galactic scales should be lowered from ~1,500 down to ~300, the main reason being that the residual interaction of matter with radiation is significant even when hydrogen ionization reaches very low values. As a consequence, galaxies would be formed later, and a long period of practically neutral hydrogen would be present between a red-shift somewhat lower than 1,500 and the red-shift approximately 300 after which matter can no longer be treated as incompressible. (DE)

30802 KINEMATIC PHENOMENA IN THE INNER REGION OF M81. Goad, J. W. Boston; Harvard Univ. (1974). 96p. University Microfilms Order No. 75-18,080.

Thesis (Ph, D.).

M81, a normal nearby spiral, is shown to be a galaxy of kinematical complexity. Chapter 1 describes in detail some of the previous observations of this galaxy; the following chapters are discussions of the velocity field for the gas in the inner 100" (1.45 kpc), derived from spectrograms in the wavelength region around H alpha. All of the plates were taken with the 2.1-meter telescope at Kitt Peak National Observatory. Chapter 2 presents results from coude spectrograms of moderately high dispersion (approximately 25 A mm^{-1}) covering the inner 5" of M81. The tilts of the gaseous emission lines are larger along the minor axis than along the major axis, and can be interpreted in terms of a flow of ionized gas out of the inner 50 pc, at a rate of approximately 10^{-2} M/sub solar mass/yr^{-1}. Chapters 3, 4, and 5 discuss the results from a set of 16 Cassegrain spectrograms (at 64 to 97 A mm^{-1}) through the nucleus of M81. The velocity curves show the inner 100" to be rotating rapidly, the maximum rotational velocities occurring at approximately 70" (1 kpc) from the nucleus. Thus the overall rotation curve of M81 must have a double-peaked structure. The gas throughout the inner 100" also exhibits strong radial motions, both toward and away from the nucleus. The outflow observed along the minor axis with the coude plates appears to be present in nearly all position angles in the plane of the galaxy. Outside this region of outflow, the gas flow is generally toward the nucleus. The convergence of the outbound and inbound flows at a radius of about 20" (290 pc) may give rise to some of the complexity of the velocity field. The causes of many of the observed motions have not been identified. But the similarities between the gas motions in M81 and M31 suggest that the picture of a normal spiral galaxy should include a complex velocity field in the central region. (Diss. Abstr. Int., B)

30803 IONIZATION OF THE INTERCLOUD MEDIUM BY O—B RUNAWAY STARS. Thuan, T. X. Princeton, NJ; Princeton Univ. (1974). 112p. University Microfilms Order No. 75-20,669.

Thesis (Ph. D.).

The ionization structure around high-velocity stars with spectral type varying from O5 to B1 is investigated. The radiative transfer problem is solved with the "on the spot" approximation and the time-dependent cooling and recombination behind the star are taken into account. The contrasting properties of the front and the back of the HII region around a moving star are studied in the case of a star with T/sub e/ equals 35000°K, moving with v/sub */ equals 50 km s^{-1} in an uniform medium of 0.1 H atoms cm^{-3}. Directly in front of the star, the ionization time of

H (equals 2.0 x 10^4 years) at the edge of the HII region is about 65 times smaller than the recombination time, steady-state is reached after about 1.5 x 10^6 years, the I-front radius is compressed (140 pc compared to 190 pc when v/sub */ equals 0), the transition from completely ionized to completely neutral is very sharp (approximately 1 pc), the optical depth at the edge very small and the ratio NI/NII 11 times smaller than its value at v/sub */ equals 0. Directly in back, the ionization time (equals 4.5 x 10^8 years) is 180 times greater than the recombination time, steady-state is reached after about 2.6 x 10^6 years, the HII region is elongated (approximately 265 pc), the transition from HII to HI is very gradual (approximately 100 pc), the optical depth at the edge large and the ratio NI/NII only 2.3 times greater than its value with the star at rest. Shock waves are confined in the back, are of short duration (approximately 5 x 10^5 years) and do not affect the development of the HII region. The same star, starting from the plane and moving upwards perpendicularly to it with v/sub */ equals 50 km s^{-1}, in a medium whose density is decreasing with height, ionizes everything ahead of it after about 0.9 x 10^6 years, with the HII region extending to roughly 240 pc in the back. The ionization structure of nitrogen is not very different from the case when the star is moving in an uniform medium. (Diss. Abstr. Int., B)

30804 LUMINOSITY FUNCTION FOR GALAXIES AND THE CLUSTERING OF GALAXIES. Schechter, P. Pasadena, CA; California Inst. of Tech. (1975). 80p. University Microfilms Order No. 75-20,012.

Thesis (Ph. D.)

An analytic representation for the luminosity function for galaxies is proposed. Best fits of this function to counts of nearby bright galaxies and to counts of galaxies in rich clusters have been obtained. The results are marginally consistent with a single luminosity function valid for both samples. The proposed representation contains a characteristic magnitude M* which exhibits an equivalent dispersion of only .24 magnitudes from cluster to cluster. The narrow dispersion in absolute magnitude observed for the brightest members of clusters is understood in large part as statistical fluctuation about a universal luminosity function, but the correlation of absolute magnitude with richness expected from the proposed representation is not observed. It is shown that galaxies will condense into clusters of the sizes presently observed if the perturbations giving rise to galaxies were randomly distributed at recombination. A model for the origin of clusters is proposed which assumes (a) that galaxies collapse without dissipation, (b) that the perturbations giving rise to galaxies are centrally condensed, and (c) that most of the matter density in the universe is in galaxies. The problem of the distribution of cluster sizes for Poisson distributed points is discussed and an analytic approach to a solution is developed. Numerical experiments show factor of two agreement with the solution obtained. It is shown that if galaxies were randomly distributed at some early epoch massive galaxies are less likely to be isolated than less massive galaxies. An observational definition of an "isolated galaxy" is offered and an observational test of the model is proposed. (Diss. Abstr. Int., B)

30805 FOUR-POINT CORRELATION AND SUPERCLUSTERING OF GALAXIES. Kalinkov, M.; Kuneva, I. F.; Gelovska, E. G. (Dept. of Astronomy, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 12, 1573-1574(1975).

The existence of second and higher order clusters of galaxies is studied. Two essentially different correlation methods applicable to two-dimensional discrete random fields allow one to determine the typical size of the configurations. (JFP)

30806 SPECTROSCOPY AND INTERFEROMETRY OF FOUR EMISSION NEBULAE. Lozinskaya, T.A.; Klement'eva, A.Y.; Zhukov, G.V.; Shenavrin, V.I. (Shternberg Astronomical Institute, Moscow, Physics Department, Moscow University, Kazan' University). Sov. Astron.—AJ 19: No. 4, 416-421 (July 1975).

The results of spectrophotometric and interferometric observations of four emission nebulae are presented. Estimates are obtained for T_e, N_e, the mean radial velocity (reduced to the Local Standard of Rest), and the velocity of internal motion in the nebulae. The objects investigated are: 1) a bright compact nebula of unknown nature 2'.5 across, identified with the nonthermal radio source G6.4−0.5 near W28; 2) the nebula RCW 171, 5' across, identified with the radio source G23.1+0.6; 3) the nebula Simeiz 34 (Sharpless 261) at $\alpha = 6^h05^m$, $\delta = +15°49'$ (1950.0), $\simeq 30'$ across; 4) the extended complex of bright emission filaments in Cygnus partially projected on the possible supernova remnant W63 at $\alpha = 20^h17^m$, $\delta = +45°30'$, $\simeq 90'$ across. (auth)

30807 BAR-LIKE OBJECTS AS POSSIBLE GENERATORS OF SPIRAL DENSITY WAVES. II. WAVE PATTERN IN A DIFFERENTIALLY ROTATING DISK. Korchagin, V.I.; Marochnik, L.S. (Rostov State University). Sov. Astron.—AJ 19: No. 4, 428-433 (July 1975).

It is shown that a "thin" bar can generate a two-arm spiral pattern in a differentially rotating disk, which is taken as a model of the flat subsystem of a galaxy. The actual wave pattern is determined by the properties of the generator and the system. A bar that rotates faster than the central parts of the flat subsystem generates a trailing spiral structure. A bar whose angular velocity is less than that of the peripheral regions of the galaxy generates a leading spiral. A bar with intermediate angular velocity generates a "multistorey" spiral structure. Lindblad resonance points far from the region of corotation have little influence on the wave pattern if the generator is a thin bar. An arbitrary nonaxisymmetric object in the center of a galaxy generates a complicated many-arm spiral structure. (auth)

30808 ON THE PHYSICAL INTERPRETATION OF CERTAIN KINDS OF MIXING IN STELLAR SYSTEMS. Osipkov, L.P. (Leningrad State University). Sov. Astron.—AJ 19: No. 4, 530-532 (July 1975).

The significance of divergent and circulation mixing in stellar systems under conditions of continuing group star formation in galaxies is discussed. (auth)

30809 RADIO CONTINUUM MEASUREMENTS OF COMPACT H II REGIONS AND OTHER SOURCES. Matsakis, D.N. (Physics Department, University of California, Berkeley, California 94720); Evans, N.J. II; Sato, T.; Zuckerman, B. Astron. J. 81: No. 3, 172-177 (Mar 1976).

The flux densities at wavelengths of 13, 4, and 2 cm have been measured for a variety of sources. The spectra of some previously known sources have been extended to higher frequencies. Physical parameters are derived where possible, assuming a model of thermal emission from ionization-bounded homogeneous, spherical H II regions. (auth)

30810 ELECTRON TEMPERATURE IN THE ELLIPTICAL GALAXY NGC 1052. Koski, A.T.; Osterbrock, D.E. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz). Astrophys. J. Lett. 203: No. 2, L49-L51 (15 Jan 1976).

Image-dissector scanner observations of the emission-line spectrum of NGC 1052 are discussed. The scan of the elliptical galaxy NGC 584 is used to remove the integrated stellar absorption-line features from the spectrum of NGC 1052. The [O III] lines indicate $T \simeq 33{,}000$ K. The observed line intensities are consistent with shock-wave heating models by Cox. (auth)

30811 FAR-INFRARED PHOTOMETRY OF NGC 1068. Telesco, C.M.; Harper, D.A.; Loewenstein, R.F. (Yerkes Observatory, University of Chicago). Astrophys. J. Lett. 203: No. 2, L53-L55 (15 Jan 1976).

We have detected the far-infrared flux from NGC 1068 in four passbands spanning the range 28–320 μ. Between 38 and 100 μ the flux density increases with increasing wavelength to a maximum value of (454±94) Jy, but clearly decreases rapidly for $\lambda > 100$ μ. The total flux is $\sim 3.0 \times 10^{-11}$ W m^{-2} corresponding to a bolometric luminosity of 3.7×10^{11} $L_\odot$ at 20 Mpc. (auth)

30812 CO OBSERVATIONS OF THE BRIGHT-RIMMED CLOUD B35. Lada, C.J.; Black, J.H. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 203: No. 2, L75-L79 (15 Jan 1976).

Detailed observations of millimeter-wave emission from ^{13}CO and ^{13}CO are made throughout the bright-rimmed molecular cloud B35 and compared with optical photographs. A ridge of enhanced ^{12}CO brightness temperature is observed directly behind and along the bright-rimmed ionization front which forms the western border of the molecular cloud. Measurements of CO column density through the cloud across both the ridge and the ionization front show that the column density peaks near the ridge and, like the CO brightness temperature, steeply decreases across the ionization front. It is shown that modification of the cloud conditions by shock waves can explain our observations and account for the observed CO cooling rates in the cloud. Cloud heating by embedded young stars is also possible, and infrared observations are suggested as a means of distinguishing between the two heating models. (auth)

30813 THE POLARIZATION OF THE INFRARED SOURCE CRL 2688 (THE EGG NEBULA). Shawl, S.J. (University of Kansas); Tarenghi, M. Astrophys. J. Lett. 204: No. 1, L25-L28 (15 Feb 1976).

Polarization observations of CRL 2688 (the Egg Nebula) show the polarization to vary from 40 percent at 3800 Å to 52 percent near 9400 Å. Observations of both components are also given. Polarization and reddening models seem to indicate graphite rather than silicate particles, with a column density of $\sim 10^9$ cm^{-2}. (auth)

30814 METHOD FOR DETERMINING MAXIMUM-LIKELIHOOD DISTANCE MODULI FOR GROUPS OF GALAXIES. Schechter, P. (Institute for Advanced Study); Press, W.H. Astrophys. J. 203: No. 3, 557-568 (1 Feb 1976).

Two new procedures for estimating distance moduli for groups of

galaxies are set forth. Both procedures construct a synthetic, characteristic apparent magnitude m^*, using the measured apparent $m_1, ..., m_N$ of the N brightest group members. The distance modulus $m^* - M^*$ then follows from a known universal absolute magnitude M^*. The observer may choose any convenient value for $N \geq 1$, with larger N giving better accuracy. The procedures for computing m^*, derived here from a maximum-likelihood statistical analysis and an empirical galaxy luminosity function, are reduced to simple numerical tables. One of the two procedures, useful only for rich clusters, is a generalization of Sandage's "single-brightest" standard candle. The other one is closely related to Abell's luminosity-function break" method, and is useful for sparse groups as well as for rich clusters. Various tests of the procedures on actual data are shown, and a detailed example of their use is included. (auth)

30815 THE DYNAMICS OF THE INTERGALACTIC MEDIUM IN THE VICINITY OF CLUSTERS OF GALAXIES. Lea, S.M. (Ames Research Center, NASA). Astrophys. J. 203: No. 3, 569-580 (1 Feb 1976).

Numerical solutions to the problem of infall of matter into clusters of galaxies are presented. It is assumed that the universe can be described by a Friedmann cosmological model with $H_0 = 50$ km s^{-1} Mpc^{-1}. It is found that physically reasonable models having $q_0 = 1/2$ lead to excessive X-ray emission from clusters of galaxies. Models including a heat flux due to thermal conduction, heating of the intracluster medium by galaxy motions, and a gas outflow from the galaxies in the cluster are discussed, and the results are compared with the observational data in both the X-ray and radio bands. It is concluded that Ω must be less than 0.2 in order that the predicted X-ray emission not exceed that observed. No models have been found which give a good description of the observed cluster X-ray sources, with the exception of a fully adiabatic model in a high-density ($\Omega = 1$) universe. Once the importance of bremsstrahlung cooling is realized, models incorporating this effect fail to accurately describe the observed sources. An adiabatic type model may result if there is a burst of heat input into the cluster at the time of its formation. (auth)

30816 CHEMICAL COMPOSITION OF H II REGIONS IN THE SMALL MAGELLANIC CLOUD AND THE PREGALACTIC HELIUM ABUNDANCE. Peimbert, M.; Torres-Peimbert, S. (Instituto de Astronomia, Universidad Nacional Autónoma de México). Astrophys. J. 203: No. 3, 581-586 (1 Feb 1976).

Photoelectric spectrophotometry of emission lines in the 3700–7400 Å range is presented for NGC 346, NGC 356, and NGC 456 in the Small Magellanic Cloud (SMC). The observations were obtained at CTIO with the 60 inch (1.5 m) telescope and the Harvard scanner. From these observations the chemical abundances of He, N, O, Ne, S, and Ar relative to hydrogen are derived. It is found that N (He)/N (H) $= 0.078 \pm 0.005$ for the three H II regions is the SMC; this value is about 25 percent smaller than the values for the Orion and η Car nebulae. Oxygen and neon are underabundant by a factor of 7, while nitrogen is underabundant by a factor of 15 in the SMC H II regions with respect to the values for the Orion Nebula. From the chemical composition of H II regions in our Galaxy and the Magellanic Clouds it is found that the pregalactic value of N (He)/N(H) is 0.074 ± 0.006 ($Y = 0.228 \pm 0.014$). The cosmological implications of this result are briefly discussed. (auth)

30817 Hα EMISSION FROM THE DISKS OF SPIRAL GALAXIES. Cohen, J.G. (Kitt Peak National Observatory). Astrophys. J. 203: No. 3, 587-592 (1 Feb 1976).

Observations of the amount of Hα emission from the disks of 53 galaxies have been made using large entrance apertures so that the maximum possible fraction of the total area of the galaxy is included. These observations reveal a relationship between $B-V$ color and Hα emission; for a given morphological type the bluer galaxies have more emission at Hα. The effect of the strong emission lines on the colors is not sufficient to produce this trend. Furthermore, the Hα emission comes from discrete H II regions ionized by starlight which are limited in the crudest approximation by the number of hot stars rather than the availability of gas. From the range in Hα emission, we obtain the ratio of hot stars to cooler stars corresponding to the observed range in $B-V$ color. We then compare this with a theoretical model by Searle, Sargent, and Bagnuolo which predicts $B-V$ color as a function of the stellar luminosity function in the galaxy. The two separate methods of determining the change in ratio of hot-to-cool stars agree well. We thus give further observational support to the models of Searle, Sargent, and Bagnuolo. (auth)

30818 A SPECTROGRAPHIC SURVEY OF 21 PLANETARY NEBULAE. Kaler, J.B. (University of Illinois Observatory); Aller, L.H.; Czyzak, S.J. Astrophys. J. 203: No. 3, 636-646 (1 Feb 1976).

We present a blue spectral survey and coarse photographic photometry for 21 planetary nebulae, of which eight have not been heretofore observed with any detail. We have observed eight of the nebulae photoelectrically. Most of the planetaries studied are of intermediate excitation; five present no detectable He II lines, and two are of high excitation with powerful He II λ4686. The chief value of the photographic part of the study is to locate objects deserving of further study. We have, however, derived rough electron densities for the nebulae from either or both of the [O II] or [Ar IV] doublet ratios, and electron temperatures from the [O III] lines. Values are generally within the normal range except for Hb 12, for which N_e may be as high as 4×10^5. (auth)

30819 PHYSICAL CONDITIONS IN A HYDROGEN GAS HEATED BY SUPRATHERMAL PROTONS. Kimmer, E. (Department of Physics and Astronomy, The University of Toledo). Astrophys. J. 203: No. 3, 674-679 (1 Feb 1976).

A self-consistent calculation has been made of the physical conditions in a pure hydrogen gas that is heated by suprathermal protons (energies greater than 200 keV). The geometry adopted is that of a plane-parallel slab with suprathermal particles incident normally. Lower and upper limits were set on the degree of ionization and temperature of the gas by calculating conditions as a function of penetration distance for (1) an optically thin gas where all radiation immediately escapes, and (2) an optically thick gas where Lα photons are trapped and destroyed on the spot by two-photon emission. The adjustable parameters used were the initial energy of the suprathermal protons, the fast-particle density, and the ambient gas density. Even with the on-the-spot approximation and no dispersion for the initial fast proton energies, conditions are roughly uniform throughout the gas. For both cases, when the gas is not completely ionized, the calculated electron temperatures are on the order of 10^4 K and the degrees of ionization are usually less than 10 percent. When the suprathermal particle density is greater than about 10^{-6} of the gas density, the gas becomes completely ionized. (auth)

30820 THE SEMISTELLAR NUCLEUS OF M33. van den Bergh, S. (David Dunlap Observatory, University of Toronto, Richmond Hill, Ontario, Canada). Astrophys. J. 203: No. 3, 764-765 (1 Feb 1976).

Spectroscopic observations suggest that the light emitted by the semistellar nucleus of M33 is dominated by relatively young stars. This observation indicates that the nuclei of some galaxies may be formed from interstellar gas rather than from an accumulation of globular clusters. (auth)

30821 OBSERVATIONS OF INTERPLANETARY SCINTILLATIONS AT 74 MEGAHERTZ. Armstrong, J. W. San Diego, CA; Univ. of California (1975). 186p. University Microfilms Order No. 76-2292.

Thesis (Ph. D.).

Three-station observations of 74 MHz interplanetary scintillations (IPS) taken during 1971 to 1974 have been processed with the aims of relating the IPS variance and third statistical moment to physical properties of the radio source and of the solar wind, and using spectra of the IPS-determined solar wind velocity to study velocity fluctuations on time scales 0.5 to 6 minutes and 2 to 100 days. In the study of the longer time scale fluctuations, the emphasis was on the relatively stable velocity features that corotate with the sun. The variance and third central moment of the IPS intensity were measured uwing the radio source PSR 0531 + 21. The skewness parameter gamma$_1$ equals (third central moment)/variance$^{1.5}$) was also measured. Solar wind velocity spectra were computed in two frequency bands. Spectra in the band 0.01 to 0.5 cycles/day were computed from data taken during 1972 to 1974.5. The velocity variance and degree of correlation after one solar rotation lag varied strongly with time while the mean solar wind velocity (at low heliographic latitudes) did not. There was no indication of systematic differential rotation of the solar wind with heliographic latitude. The average parameters of the 1972 to 1974.5 velocity data were, where comparisons were possible, in good agreement with the average parameters of spacecraft-measured velocity data taken in the mid-1960's. (Diss. Abstr. Int., B)

30822 STRUCTURE OF PLANETARY NEBULAE. Goad, L. E. Cambridge, MA; Harvard Univ. (1975). 133p. University Microfilms Order No. 76-4474.

Thesis (Ph. D.).

Image-tube photographs of planetary nebulae taken through narrow-band interference filters are used to map the surface brightness of these nebulae in their most prominent emission lines. These observations are best understood in terms of a two-component model consisting of a tenuous diffuse nebular medium and a network of dense knots and filaments with neutral cores. The observations of the diffuse component indicate that the inner regions of these nebulae are hollow shells. This suggests that steady stellar winds are the dominant factor in determining the structure of the central regions of planetary nebulae. The observations of the filamentary components of NGC 40 and NGC 6720 show that the observed nebular features can result from the illumination of the inner edges of dense fragmentary neutral filaments by the central stars of these nebulae. From the analysis of the observations of the low-excitation lines in NGC 2392, it is concluded that the rate constant for the $N^+ - H$ charge transfer reaction is less than 10^{-12} cm^3 sec^{-1}. (Diss. Abstr. Int., B)

30823 HYDRODYNAMIC SHAPING OF PLANETARY NEBULAE. Kirkpatrick, R. C. (Los Alamos Scientific Lab., N. Mex.). Astrophys. Lett.; 17: No. 1, 7-9(1976).

Starting with a slightly oblate spheroidal atmosphere which one would expect for a rotating star, it is shown that a uniform pressure along an equipotential surface transforms the oblate atmosphere into an expanding prolate spheroidal nebular shell, such as those deduced by Weedman for several planetaries. (auth)

30824 COMPUTER STUDY OF GALACTIC SPIRAL ARM SHAPES. Barricelli, N. A. (Univ., Oslo); Havnes, O. Astrophys. Lett.; 17: No. 1, 37-44(1976).

A galactic explosion model is used in a computer program for a first approach interpretation of spiral arm shapes and velocity distributions in the galaxies M 31 and M 33. A refinement of the model is proposed and its implications for galactic dimensions are presented. (auth)

30825 DETERMINATION OF HELIUM AND OXYGEN ABUNDANCES IN GASEOUS NEBULAE. Pronik, V. I. Izv. Krym. Astrofiz. Obs.; 53: 202-208(1975). (In Russian).

On the basis of observing numbers of O II and O III ions a method of determining oxygen abundance is proposed. The graphs for He/H and O/H abundances are presented using the observed relations I (4686)/I (H_β), I (4471)/I (H_β) and I (3727)/I (H_β), I(N_1 + N_2) /I (H_β). (auth)

30826 RADIO STRUCTURE AND EXTINCTION CURVE FOR IC 3568. Sistla, G.; Kaftan-Kassim, M. A. (State Univ. of New York, Albany). Astrophys. Lett.; 17: No. 1, 49-51(1976).

Radio continuum observations of the Planetary nebula IC 3568, with a resolution of 6 and 2 arc sec. are presented. In sharp contrast to the optical appearance of the nebula, the synthesized radio map at the higher resolution exhibits structural details. A value of 0.23 for the total nebular extinction c at H_β is derived and compared with earlier estimates. A systematic deviation from the mean reddening law is found for the higher Balmer lines which may be attributed either to true departures from the theoretical Balmer decrement or to the presence of internal nebular dust. (auth)

30827 RADIATIVE-LIFETIME MEASUREMENTS FOR SULFUR AND SILICON TRANSITIONS OBSERVED IN INTERSTELLAR ABSORPTION SPECTRA. Livingston, A. E. (Univ., Liege); Garnir, H.; Buadinet-Robinet, Y.; Dumont, P. D.; Biemont, E.; Grevesse, N. Astrophys. Lett.; 17: No. 1, 23-25(1976).

The beam-foil technique is used to measure radiative lifetimes and derive oscillator strengths for several transitions in S III, Si II and Si III are observed in interstellar absorption spectra. The first experimental f-value for the 1018 Å multiplet in S III (f = 0.036 ± 0.004) is reported and a recent revision of the f-value for 1194 Å in Si II is confirmed.

Cosmology

Refer also to abstracts 30510, 30678, 30683, 30773, 30775, 30776, 30778, 30779, 30801, 30814–30816, 30853, 31453, 31494, 32110, and 32114.

30828 STROENIE I EVOLYUTSIYA VSELENNOI. (Structure and Evolution of the Universe). Zel'dovich, Ya. B.; Novikov, I. D. Moscow; Izdatel'stvo Nauka (1975). 735p.

Both the classical principles of cosmology and its latest problems are examined. These include the theory of the expanding hot universe, the problems of singular states in the past, physical processes at different stages of cosmological expansion, gravitational instability, and the formation of galaxies. The classical problems examined in detail are the geometry of the universe, the movement of matter, and propagation of light in an expanding universe. Data are included on the general theory of relativity, theory of elementary particles, and physical statistics. (tr-auth)

30829 COOLING OF THE INTERGALACTIC GAS IN FRIEDMANN UNIVERSES. Jaaniste, J. Publ. Tartu. Astrofiz. Obs.; 42: 188-209(1974). (In Russian)

The thermal evolution of intergalactic matter is studied. Generalized Friedmann cosmological models with radiation are used as the background ones. Formulas for the temperature and degree of ionization of the gas are derived. Results of the numerical calculations on the cooling of the hydrogen-helium gas after the secondary heating are given. The initial temperature at z = 3, about 10^6°K, appears to be high enough to explain the observed lack of absorption by neutral hydrogen in the spectra of distant quasars. The resulting background of thermal radiation does not contradict observations. (auth)

30830 EINSTEIN–CARTAN EQUATIONS IN ASTROPHYSICALLY INTERESTING SITUATIONS. II. Homogeneous Cosmological Models of Axial Symmetry. Kuchowicz, B. (Univ., Warsaw). Acta. Phys. Pol., Ser. B7: No. 2, 81-97(Feb 1976).

The three classes of axially symmetric space-times, corresponding to homogeneous cosmological models which are filled with perfect fluid are studied in the framework of the Einstein-Cartan theory of gravitation. A general set of equations is given with the admissible non-vanishing torsion and spin components compatible with the symmetry. This is further specialized to the "generalized classical description" of spin, and the "classical description" with only one survivng spin tensor component. Closed and open models have to be necessarily shearing while Euclidean models admit also a zero value of shear. A general expression for shear in all classes of models is derived; it is helpful in proving that the singularity may be prevented in the Einstein-Cartan theory thanks to the repulsive spin-spin interaction. This is possible even in those semiclosed models which do not permit any simply transitive group of motions; they may constitute authentically pulsating models with shear and torsion. (auth)

30831 PROPAGATION OF ELECTROMAGNETIC RADIATION IN A NONUNIFORM UNIVERSE. Patel, L. K. (Gujarat Univ., Ahmedabad, India). Vidya; 17: No. 1, 76-79(1974).

It is shown that the full retarded solutions are not consistent and the full advanced solutions are consistent in such a cosmological model. (auth)

30832 PROGRESS AND PROSPECTS IN HIGH ENERGY ASTROPHYSICS. Rees, M. J. (Inst. of Astronomy, Cambridge, Eng.). Proc. Natl. Acad. Sci. U.S.A.; 72: No. 12, 4685-4690(Dec 1975).

Some current ideas on neutron stars, black holes, and the early universe are discussed. (auth)

30833 (QUANTIZATION OF COSMOLOGICAL MODELS WITH UNIFORM SPACE). Gusakov, V. S. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 66-70(1975). (In Russian).

30834 NONSINGULAR COSMOLOGICAL MODELS IN SCALAR-TENSOR THEORY OF GRAVITATION. Antonov, V. I.; Vladimorov, Yu. S. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 121-129(1975). (In Russian).

30835 PROBLEMS OF THE GRAVITATIONAL COLLAPSE. Krechet, V. G.; Lapchinskii, V. G.; Ponomarev, V. N.; Stanyukovich, K. P. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 129-139(1975). (In Russian).

30836 DIFFERENTIAL METHOD FOR THE REGISTRATION OF A FLUCTUATING GRAVITATIONAL SIGNAL. Gusev, A. V. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 190-194(1975). (In Russian).

30837 PHASE DATA DURING FILTRATION OF SIGNALS IN GRAVITATIONAL EXPERIMENTS. Gusev, A. V. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 194-197(1975). (In Russian).

30838 ONE METHOD FOR DETECTING GRAVITATIONAL WAVES BY MEANS OF A TORSION PENDULUM. Shirokov, M. F.; Bondarev, B. V. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 205-206(1975). (In Russian).

30839 NEW METHOD FOR VERIFICATION OF THE EFFECT OF LIGHT BENDING IN THE GRAVITATIONAL FIELD OF THE SUN. Shirokov, M. F.; Bondarev, B. V. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 206-212(1975). (In Russian).

30840 LOCAL APPROACH TO COSMOLOGY. Walstad, A. M. Amherst, MA; Univ. of Massachusetts (1975). 99p. University Microfilms Order No. 75-27,529.

Thesis (Ph. D.).

A local approach to cosmology is developed in which it is attempted to understand, from strictly local considerations, the principal observable properties of homogeneous cosmological models. The local line element is obtained for some simple general-relativistic models. The optical appearance of distant objects, number counts, and the effects of local inhomogeneities on such observations are discussed in the isotropic case. The concept of the partitioned universe, in which physical conditions are mimicked by conditions inside a small, expanding cell with perfectly reflecting walls, is developed as a tool for simplifying the discussion of the background radiation, Olbers' paradox, the temperature and physical state of the cosmological fluid, entropy generation, and the effects of anisotropic expansion. This treatment reveals a possible error in Weinberg's (1971) discussion of bulk viscosity and entropy generation in the early universe. (Diss. Abstr. Int., B)

30841 ROTATION OF THE UNIVERSE. Fennelly, A. J. New York; Yeshiva Univ. (1975). 143p. University Microfilms Order No. 75-20,584.

Thesis (Ph. D.).

The present beliefs in cosmology are reviewed. It is demonstrated that the Copernican or "modesty" principle is neither Copernican nor modest. Previous formalisms developed mainly in Cambridge, Maryland, and Moscow are critically examined. The theorems of the Cambridge group result from assumptions made with causality and other space–time properties in mind. A counter example to these theorems is exhibited. A formalism is developed by transforming a standard metric form to null coordinates and decomposing it into a null tetrad. A complete set of rotating Friedman universes can be generated. The geodesics are calculated. Rotation may be redefined in terms of translations in doubly-connected manifolds. A simply-connected Bianchi type I universe can possess vorticity if it has two space-like velocity components nonzero. New formulae are derived for observational effects, including the distortion effect, the apparent proper motion of sources, and the number counts. The isotropy of the microwave background radiation is criticized as looking isotropic, when the universe may in fact not be, particularly since the standard formulae show the rotation and shear may cancel each other and the universe could possess nonzero vorticity and still look isotropic. Recent observations or analyses show that there may be an anisotropy in the number counts of radio sources, in homogeneities in the velocity field of distant galaxies and distribution of galaxy clusters, and that the number counts of radio sources cannot be explained by evolution alone. It is shown how a rotation can explain the number counts of radio sources, as well as all other observations. It very well may be concluded, therefore, that the universe is rotating. (Diss. Abstr. Int., B)

30842 FROZEN SCINTILLATION CAUSED BY LOW-FREQUENCY GRAVITATIONAL RADIATION. Dautcourt, G. (Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Astrophysik). Astron. Nachr.; 296: No. 3, 119-123(1975).

Intense low-frequency cosmic gravitational radiation in the Megaparsec wave band courses among other effects a small angular displacement of distant light sources. A short treatment of the effect is given. (GC)

30843 ATTENUATION OF INTERNAL GRAVITY WAVES IN MODEL ATMOSPHERES. Yeh, K. C.; Liu, C. H.; Youakim, M. Y. (Illinois Univ., Urbana (USA). Dept. of Electrical Engineering). Ann. Geophys.; 31: No. 2, 321-328(Apr 1975).

The propagation of internal acoustic-gravity is known to be associated with the transport of kinetic energy, elastic energy and thermobaric energy. In a lossy atmosphere these energies are converted into heat through dissipative processes of viscosity, thermal conduction and ion drag. As a result, these waves are damped. Depending on wave parameters the atmosphere may appear opaque or transparent or in-between. Computations made for several model atmospheres indicate minimum damping when the period is between the buoyancy period and the period of about 60 min. The results show that, for most waves except those propagating nearly horizontally, the thermal conduction is slightly more important in damping waves than the viscosity. (FR)

30844 RESOURCE LETTER RC-1: COSMOLOGY. Ryan, M.P. Jr. (Centro de Estudios Nucleares, Universidad Nacional Autónoma de México, México 20, D.F., México); Shepley, L.C. Am. J. Phys. 44: No. 3, 223-230 (Mar 1976).

Prepared at the request of the AAPT Editorial Board for Resource Letters. This is one of a series of Resource Letters on different topics intended to guide college physicists, astronomers, and other scientists to some of the literature and other teaching aids that may help improve course contents in specified fields. No Resource Letter is meant to be exhaustive and complete; in time there may be more than one letter on some of the main subjects of interest. Comments on these materials as well as suggestions for future topics will be welcomed. Please send such communications to Professor Aaron Owens, Editor, Resource Letter Board, Department of Physics, Lake Forest College, Lake Forest, Illinois 60045. *Notation*: The letter E after an item number indicates elementary level; the letter I indicates intermediate level; and the letter A indicates advanced material. An asterisk (*) indicates those references we feel to be especially helpful. *Reprints*: When ordering, request Resource Letter RC-1. Enclose 75 cents per copy (not in stamps) together with a stamped and self-addressed envelope and send to Melba Phillips, Acting Executive Officer, American Association of Physics Teachers, Graduate Physics Building, SUNY at Stony Brook, Stony Brook, New York 11794. (auth)

30845 POSSIBLE EXPERIMENT WITH TWO COUNTER-ORBITING DRAG-FREE SATELLITES TO OBTAIN A NEW TEST OF EINSTEIN'S GENERAL THEORY OF RELATIVITY AND IMPROVED MEASUREMENTS IN GEODESY. Van Patten, R.A.; Everitt, C.W.F. (Department of Aeronautics and Astronautics and W. W. Hansen Laboratories of Physics, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 36: No. 12, 629-632 (22 Mar 1976).

In 1918, Lense and Thirring calculated that a moon orbiting a rotating planet would experience a nodal dragging effect due to general relativity. We describe an experiment to measure this effect to 1% with two counter-orbiting drag-free satellites in polar earth orbit. In addition to tracking data from existing ground stations, satellite-to-satellite Doppler ranging data are taken near the poles. New geophysical information is inherent in the polar data. (auth)

30846 COSMOLOGICAL NEUTRINO BACKGROUND. Lucey, C.A. (Physics Department, Jamestown Community College, Jamestown, New York 14701). Phys. Rev. D 13: No. 6, 1527-1531 (15 Mar 1976).

This paper surveys the question of the cosmological neutrino background and the evidence for and against it. It is suggested that more conclusive evidence for an upper limit on the chemical potential of muon neutrinos might be available from a study of the charge-asymmetry magnitude of the $K^0 \rightarrow \pi\mu\nu$ decay. (auth)

30847 MISSING MASS. Margon, B. (Univ. of California, Berkeley). Mercury; 4: 2-6(1975).

Evidence is discussed that points to the existence of large amounts of unaccounted-for matter in galaxy clusters such as the Coma cluster. Random motions of member galaxies calculated from their red shifts indicate that within the 4.5-billion-year history of the universe, the galaxies would have dispersed unless strong gravitational forces counteracted their dispersion. The mass of the galaxies themselves is too small by a factor of 7 to account for these forces. It may be that the form of most of the matter in the universe is unknown to us. (IAA)

Planetary Phenomena

Refer also to abstracts 28438, 29421, 30519, 30769, 30932, 30979, and 30986.

30848 (AD/A-006127) NON-STELLAR SOURCES OF CELESTIAL BACKGROUND RADIANCE. Final Report, 1 Aug 1970-30 Jun 1974. Sinton, W. M. (Hawaii Univ., Honolulu (USA). Inst. for Astronomy). Nov 1974. Contract F19628-71-C-0008. 19p. NTIS $3.25.

Observations of solar system objects obtained with the 61- and 224-cm telescopes on Mauna Kea are summarized. The programs have included studies of an 11.7/cm emission line in the earth's atmosphere, the 22-degree suspected halo in the Venus atmosphere, possible post-eclipse brightening of Io, observations of mutual occultations and eclipses of Galilean satellites, and radiometric observations at wavelengths of 20 micrometers and longer of Jupiter, Saturn, its rings, several Saturn satellites, and Trojan asteroids. (GRA)

30849 (ORNL-5129) REACTIONS OF ATMOSPHERIC VAPORS WITH LUNAR SOIL. Fuller, E. L. Jr.; Agron, P. A. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 78p. Dep. NTIS $5.00.

Detailed experimental data have been acquired for the hydration of the surfaces of lunar fines. Inert vapor adsorption has been employed to measure the surface properties (surface energy, surface area, porosity, etc.) and changes wrought in the hydration-dehydration processes. Plausible mechanisms have been considered and the predominant process involves hydration of the metamict metallosilicate surfaces to form a hydrated laminar structure akin to terrestrial clays. Additional credence for this interpretation is obtained by comparison to existing geochemical literature concerning terrestrial weathering of primary metallosilicates. The surface properties of the hydrated lunar fines are compared favorably to those of terrestrial clay minerals. In addition, experimental results are given to show that fresh disordered surfaces of volcanic sand react with water vapor in a manner virtually identical to the majority of the lunar fines. The results show that ion track etching and/or grain boundary attack are minor contributions in the weathering of lunar fines in the realm of our microgravimetric experimental conditions. 14 references. (auth)

30850 SIMULATION OF THE INTERACTION OF COSMIC RAYS WITH THE LUNAR SURFACE BY PROTON BOMBARDMENT OF A "THICK TARGET". Pt. 1. Reactions of Low Energy Neutrons. Michel, R.; Weigel, H.; Kulus, H.; Herr, W. (Koeln Univ. (F. R. Germany). Inst. fuer Kernchemie). Radiochim. Acta; 21: No. 3/4, 169-178(1974).

A "Thick Target" of approximately 170 kg artificial lunar regolith was irradiated with 600 MeV protons (total dose $\psi = 2.04 \times 10^{16}$ p). The production of low energy neutrons ($E_n \leq = 1$ keV) was studied by neutron capture in ^{59}Co, ^{63}Cu, ^{186}W, ^{191}Ir, and ^{197}Au monitors. An Au-Cd ratio of 2.1 was measured and a practically uniform neutron energy spectrum was observed throughout the whole target assembly. So an independent determination of the energy and spatial distribution of the neutrons was possible. The

n-spectrum was found to consist of a "hardened" Maxwellian (n-temperature 906 K) in the thermal region. In the epithermal an energy spectrum proportional to $E^{-1.02\pm0.08}$ resulted. The depth dependence of the neutrons is characterized by a transition maximum at 60 g/cm^2 and by a nearly exponential decrease for larger depths. The results are discussed with respect to former theoretical calculations, the Lunar Neutron Probe Experiment and the lunar N-induced isotopic effects in the elements Gd, Sm, Kr, Xe, Re, etc. (DE)

30851 COSMOGENIC ^{26}Al AND ^{22}Na IN STONE METEORITES. Lavrukhina, A. K.; Gorin, V. D. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Meteoritika; No. 34, 49-51(1975). (In Russian).

This study reports the results of radioactivity measurements of the cosmogenic isotopes Al-26 (half-life of 7.38×10^5 years) and Na-22 (half-life of 2.6 years) in recently fallen chrondrites of Lost City, Denver, Allende, Tathlith, and also in chrondrites of Pribram and Okhansk. Measurements were carried out on a low-background, scintillation gamma-spectrometer by gamma-gamma coincidence counting. The Al-26 activity in counts/min.kg was found to be 53 to 60, while the Na-22 activity was 80 to 95. Comparison with literature data shows good agreement. (SJR)

30852 METALLOGRAPHIC STUDY OF A FRAGMENT OF LUNAR MATERIAL OBTAINED BY "LUNA-16" FROM MARE FECUNDITATIS. Mints, R. I.; Petukhova, T. M.; Segal, V. M. (Ural Polytechnic Inst., Sverdlovsk, USSR). Meteoritika; No. 34, 92-97(1975). (In Russian).

Various morphotypes of martensite were detected and described in a lunar nickel-iron sample. Traces of secondary recrystallization were manifested. An analysis was made of the deformation substructure of the fragment. Polymorphic transformations in microvolumes were realized, mainly because of a shift mechanism. The deformation substructure was formed by diffusion processes. It is proposed that the fragment has a meteoric origin. The structural-morphological details were caused by cosmogenic metamorphism under lunar conditions. 13 refs. (SJR)

30853 EFFECT OF LOW-FREQUENCY GRAVITATIONAL WAVES UPON ORBITAL ELEMENTS. Salmistraro, F. (Pavia Univ., Italy). Lett. Nuovo Cim.; 15: No. 10, 343-346(6 Mar 1976).

Previously the action of a cosmological spectrum of gravitational waves upon the orbital elements of the solar system was examined with the general result that they execute a random walk by coupling with spectral components at frequencies multiple of the orbital frequency. Attention is given to gravitational waves of low frequency, that is, lower than typical planetary frequencies. The results are interpreted as the loss of two effective degrees of freedom by the perturbing field, and it is noted that the relations obtained give information more on the modified geometry of space–time than on gravitational waves. (JFP)

30854 CONTRIBUTIONS TO PLANETARY EXPLORATION BY MAGNETIC FIELD MEASUREMENTS. Neubauer, F. M. (Tech Univ. Braunschweig, Ger). Raumfahrtforschung; 18: No. 5, 213-218(1974).

It is shown that magnetic observations in the vicinity or on the surface of the planets and satellites of the solar system constitute an important source of information on the interiors, ionospheres and magnetospheres of these bodies. Application of the techniques of geomagnetism yielded important results on the Earth. These techniques and the results on the interior of the Earth are discussed briefly. The great scientific potential of magnetic exploration of the planetary system is illustrated by three examples: The general magnetic fields of Jupiter and Saturn, the Jovian satellite Io and the magnetosphere, ionosphere and interior of Mars. 25 refs.

30855 PRELIMINARY REPORT OF RESULTS FROM THE PLASMA SCIENCE EXPERIMENT ON MARINER 10. Bridge, H. S. (Massachusetts Inst. of Tech., Cambridge); Lazarus, A. J.; Ogilvie, K. W.; Scudder, J. D.; Hartle, R. E.; Asbridge, J. R.; Bame, S. J.; Feldman, W. C.; Siscoe, G. L.; Yeates, C. M. pp 501-519 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116–.

Results obtained from the plasma science experiment during the Mariner 10 encounters with Venus and Mercury are described. Results at Venus confirm and extend earlier results by Mariner 5, Venera 4 and Venera 6. They show that the solar wind interaction with the planet most probably involves a bow shock rather than an extended exosphere, but that the "shock" is not a thin boundary at the point where it was traversed by Mariner 10. Prior to the shock crossing a marked reduction in the flux of electrons with energies greater than 100 eV was observed. This reduction is interpreted as evidence for some direct interaction between solar wind electrons and the exosphere. Near Mercury the data show a fully developed bow shock and "magnetosheath" and provide unambiguous evidence for a strong interaction between Mercury and the solar wind. Inside the sheath there is a distinct region analogous to the magnetosphere or magnetotail of Earth, populated by electrons with lower density and higher temperature than the electrons observed in the solar wind or "magnetosheath." At the time of encounter, the external solar wind conditions were such that a perpendicular shock was observed on the inbound leg and a parallel shock was observed on the outbound leg of the trajectory, and energetic plasma electron events were detected upstream from the outbound shock crossing. The data clearly indicate that the obstacle to solar wind flow is magnetic, either intrinsic or induced. The particle fluxes and energy spectra show large variations while the spacecraft is inside the "magnetosphere"; and these variations could be either spatial or temporal. (auth)

30856 ELECTRONS AND PROTONS IN JUPITER'S RADIATION BELTS. Mogro-Campro, A.; Fillius, R. W.; McIlwain, C. E. (Univ. of California, San Diego, La Jolla). pp 521-528 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The UCSD experiment on Pioneer 10 measured fluxes of electrons and protons in Jupiter's magnetosphere. Radial profiles of electrons with energies greater than 0.16, 9 and 35 MeV and of protons of energy > 80 MeV for the region $R \lesssim 13$ Jovian radii are presented. Particle absorption by the inner Jovian satellites is discussed. It is shown that the particle-satellite collision time, the radial diffusion coefficient, and the resulting absorption probability are expected to be functions of particle energy and species, in qualitative agreement with observations. Possible causes for the observed decrease of proton flux at $R \lesssim 3.5$ Jovian radii are also discussed. (auth)

30857 COSMIC DUST INFLUX TO THE EARTH. Hughes, D. W. (Univ. of Sheffield, Eng.). pp 531-539 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The influx of cosmic dust to the earth's surface has been deduced from observations obtained by satellite-borne detectors, from the analysis of backscatter radio echoes off meteor trails, and from visual meteor counts. Observations of zodiacal light have also been used to deduce a value for the density of cosmic dust in space. Recent measurements of the geocentric velocity of particles in the cosmic dust cloud have also been reviewed. These observations are combined to give a value for the total influx of cosmic dust to the earth (in the mass range 10^{-13} g to 10^6 g) and the spatial density of this dust at 1 AU from the sun. (auth)

30858 NEAR-EARTH COSMIC DUST FLUXES OBTAINED FROM SKYLAB EXPERIMENTS. Hemenway, C. L. (Dudley Observatory, Albany); Hallgren, D. S.; Tackett, C. D. pp 541-547 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Three exposures (34, 46 and 33 days) of thin films and polished metal plates with a total area of 0.12 m^2 per exposure were carried out during the Skylab S-149 experiment. First study of the materials recovered indicates that the S-149 experiment contains important information concerning cosmic dust in the near-earth vicinity. Craters and penetration holes have been found ranging from 135 μm. A cosmic dust flux curve in the mass range 10^{-16}–10^{-7} grams is presented. Directional characteristics and evidence of particle fragility are seen in penetration holes in the multilayer thin film materials exposed. Preliminary composition data concerning the particle residue within the copper crater walls are given. (auth)

30859 INTERPLANETARY AND NEAR JOVIAN DUST ENVIRONMENT: SOME EXPERIMENTAL RESULTS. Alvarez, J. M.; Humes, D. H.; Kinard, W. H.; O'Neal, R. L. (Langley Research Center, Hampton, VA). pp 549-554 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The cosmic dust environment in interplanetary and near Jovian space has been measured by Langley Research Center experiments on board Pioneers 10 and 11. The Pioneer 10 experiment detects microparticles capable of penetrating 25 μm steel sheet, while the Pioneer 11 experiment detects microparticles penetrat-

ing 50 μm steel sheet. Analysis of the Pioneer 10 and 11 penetration experiment observations shows that there is a gap in the cosmic dust environment. The gap starts at 1.16 AU, as observed in both experiments, and extends to 1.35 AU on Pioneer 10 and 1.70 AU on Pioneer 11. The mechanism responsible for it is not well understood. Our experiments indicate that the asteroid belt does not play a significant role in the production of 10^{-8}–10^{-9} g particles. The penetration rates from both experiments decrease with increasing solar distance with no evidence of an increased meteoroid population in the asteroid belt. Analysis of the Pioneer 10 Jupiter encounter data indicates that the two-orders-of-magnitude rise in penetration rate at Jupiter periapsis is apparently due to Jupiter's strong gravitational field. (auth)

30860 COMETARY CONTRIBUTION TO COSMIC DUST. Hughes, D. W. (Univ. of Sheffield, Eng.). pp 565-572 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Recent measurements of the flux of particulate matter into the solar system produced by the break up of comets are reviewed. Processes whereby the resulting meteor stream decays into the solar system dust cloud are investigated. The value of the exponent s_m in the inverse power law describing the differential distribution of meteoroid mass changes during this decay and the magnitude of this change also varies as a function of the particle mass. Results are presented showing the effect this decay process has on the mass of particles, ψ, in each logarithmic mass interval (the interval 10^n–10^{n+1} g where n is an integer). The values obtained for the variations in s and ψ give a new insight into the meteoroid structure and to the possible particle-particle collision processes which take place in the solar system dust cloud. (auth)

30861 DISTRIBUTION OF DUST ALONG THE EARTH'S ORBIT DEDUCED FROM SATELLITE MEASUREMENTS OF ZODIACAL LIGHT. Levasseur, A. C.; Blamont, J. E. (CNRS, Verrieres-le-Buisson, France). pp 573-578 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The zodiacal light intensity has been measured for 26 months from the D2A satellite. The elongation was 90° degrees. Under normal conditions, the intensity remained between 57 S_{10} (vis)* at the ecliptic poles and 150 S_{10} (vis) at the equator. It was observed to vary slowly at high ecliptic latitudes with a one-year period. It could also increase rapidly from one day to the next; such increases occurred sometimes over a limited part of the sky. The parallel trends of the evolution with time for selected directions in two consecutive years show that the variations are due to the position of the earth in its orbit. Long-period variations are explained by a zodiacal cloud symmetrical with respect to the solar system invariant plane. Small-period increases may be due to local meteor streams. (auth)

30862 LUNAR MAGNETIC FIELD. Russell, C. T.; Coleman, P. J. Jr.; Schubert, G. (Univ. of California, Los Angeles). pp 621-628 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Apollo 15 and 16 subsatellite magnetometer observations in the geomagnetic tail lobes have been used to map the fine scale lunar magnetic field. These maps have been supplemented indirectly by observations of lunar limb compressions and of scattered energetic electrons and directly by observations in the lunar wake when the moon is in the solar wind. These data confirm the direct observations of strong localized fields on the lunar farside, and show the existence of many weaker nearside magnetic features. Combining Apollo 15 and 16 measurements of the permanent dipole moment, a southward directed moment inclined at an angle of 34° to the lunar rotational pole, with a strength of 11×10^{18} Γ cm^3 is obtained. However, these data are also consistent with zero moment. The Apollo 16 measurements show that the induced dipole moment is negative, in agreement with the previously reported Apollo 15 measurements, suggesting the moon has a weak ionosphere when it is in the lobes of the geomagnetic tail. (auth)

30863 A LOCAL DIFFUSION PROCESS ASSOCIATED WITH THE SWEEPING OF ENERGETIC PARTICLES BY IO. Huba, J.D. (Department of Physics and Astronomy, University of Maryland); Wu, C.S. Astrophys. J. 203: No. 1, 268-278 (1 Jan 1976).

A local, turbulent diffusion process which may rapidly refill the partial cavity of energetic particles created by Io's passage through a flux tube is discussed. A model is developed of Io's sweeping action on energetic particles in which a wake is formed behind the flux tube threading Io. It is shown to be possible that this wake contains an excess of positive charge, thereby creating an electric field. The particle drift produced by this field, coupled with the density gradient of energetic protons, can generate an instability. It is this instability that is responsible for the turbulent diffusion process. The sweeping of energetic particles is also discussed in relation to particle energy and pitch angle distribution. (auth)

30864 ^{244}Pu IN LUNAR ROCKS FROM FRA MAURO AND IMPLICATIONS REGARDING THEIR ORIGIN. Marti, K.; Lightner, B. D.; Lugmair, G. W. (Univ. of California, San Diego). Moon; 8: 241-250(1973).

The evidence for in situ produced fission xenon from ^{244}Pu in rock 14321 is presented. The inferred abundance ratio $^{244}Pu/^{238}U$ is found to be consistent with values observed in a meteorite. Data from a stepwise release of the xenon permits a characterization of the trapped component, which can be shown to be distinct from solar xenon. The evidence for the presence of fission gases and of uncorrelated radiogenic argon in this and in other Apollo 14 rocks are discussed as well as implications regarding their origin. (auth)

30865 DETERMINATION OF THE AMMONIA CONTENT OF JUPITER'S ATMOSPHERE. Ibragimov, N.B. (Shemakha Astrophysical Observatory of the Academy of Sciences of the Azerbaidzhan SSR). Sov. Astron.—AJ 19: No. 4, 546-548 (July 1975).

The fine structure of the NH_3 absorption band at 6450 Å in spectrograms of Jupiter has been studied. These spectrograms were obtained with a two-meter reflector and with a dispersion of 6 Å/mm. Equivalent widths and half-widths have been determined for 20 lines of the band. By comparing these data with laboratory data, the amount of ammonia in the planet's atmosphere has been estimated to be (17±4) m-atm. A comparison of spectrograms of Jupiter and of the moon has shown that strong variation occurs in the NH_3 band at 6450 Å. From the half-widths of the lines of this band, the pressure at the level of their formation has been estimated. (auth)

30866 AZIMUTHAL BRIGHTNESS VARIATIONS OF SATURN'S RINGS. Lumme, K.; Irvine, W.M. (Department of Physics and Astronomy, University of Massachusetts). Astrophys. J. Lett. 204: No. 1, L55-L57 (15 Feb 1976).

Saturn's ring A exhibits a variation in brightness with azimuth (with orbital phase of the ring particles). Maximum brightness occurs at about θ=45° and θ=225° and minimum brightness at about 135° and 315°, where the eastern ansa is taken as θ=0°. No such effect appears to exist for ring B. (auth)

30867 ON JOVIAN TEMPERATURE PROFILES OBTAINED BY INVERTING THERMAL SPECTRA. Wallace, L.; Smith, G.R. (Kitt Peak National Observatory). Astrophys. J. 203: No. 3, 760-763 (1 Feb 1976).

Defects in the inversion of observed thermal infrared spectra of Jupiter to obtain temperature structures are reviewed. An ambiguity is noted when the 7.8 μ band of CH_4 is used and alternative temperature structures are obtained. (auth)

30868 SUNSPOT CYCLE AND JUPITER'S DECAMETRIC RADIATION. Miller, H. R. (Georgia State Univ., Atlanta). Bull. Ga. Acad. Sci.; 34: No. 1, 21-23(Jan 1976).

An analysis is made of the correlation between the average intensity and the total power of the emitted decametric radiation and solar activity. It is concluded that neither the total power nor the average intensity are very sensitive to long-term changes in the level of solar activity. (BJG)

30869 WAVELENGTH DEPENDENCE IN RADIO-WAVE SCATTERING AND SPECULAR-POINT THEORY. Tyler, G. L. (Stanford Univ., CA). Radio Sci.; 11: No. 2, 83-91(Feb 1976).

Radio-wave scattering from natural surfaces contains a strong quasispecular component that at fixed wavelengths is consistent with specular-point theory, but often has a strong wavelength dependence that is not predicted by physical optics calculations under the usual limitations of specular-point models. Wavelength dependence can be introduced by a physical approximation that preserves the specular-point assumptions with respect to the radii of curvature of a fictitious, effective scattering surface obtained by smoothing the actual surface. Wavelength dependence of the scattering, as expressed in terms of the mean-square tilt of the smoothed surface, then depends on an integral of the two-dimensional surface power spectral density. A uniform low-pass filter model of the scattering process yields explicit results for the effective surface roughness versus wavelength. Interpretation of experimental results from planetary surfaces indicates that the asymptotic surface height spectral densities fall at least as fast as an inverse cube of spatial frequency. Asymptotic spectral densities for Mars and portions of the lunar surface evidently

decrease more rapidly, at least as fast as an inverse fourth or fifth law of the spatial frequency. (auth)

30870 DIELECTRIC PROPERTIES OF THE MATERIAL OF THE UPPER LAYER OF MARS FROM THE RESULTS OF BASED-GROUND MEASUREMENTS OF ITS RADIO EMISSION. Kislyakov, A. G.; Krotikov, V. D.; Shchuko, O. B. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 12, 1770-1776(1975). (In Russian)

The results of measurements of the Martian effective radio temperature obtained during oppositions 1963–1971 in the range 0.23–21 cm are analyzed. The integral emission spectra of the planet are calculated for concrete data of observations and they are compared with experimental data. As a result the mean dielectric characteristics of the upper layer of Mars are determined. The dielectric permittivity and specific tangent of the loss angle appeared to be equal to $\epsilon = 3.4 \pm 0.3$ and $b = (5 \pm 2) \cdot 10^{-3}$, respectively. The characteristic parameter $M = l_\phi / l_T \lambda$ for Mars is equal to 4.6 ± 1.0 that is approximately two times greater the corresponding lunar parameter. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 28795, 30506, 30707, 30751, 30848, 30977, 30995, and 30996.

30871 (AD/A-006134) VISIBLE AND INFRARED RADIATIONS FROM THE ATMOSPHERE ACCOMPANYING PCA EVENTS. Final Report, 1 Sep 1973–31 Aug 1974. Kofsky, I. L.; Schroeder, J. W. (Photometrics, Inc., Lexington, Mass. (USA)). 30 Sep 1974. Contract F19628-74-C-0037. 96p. NTIS $4.75.

To optimize use of solar proton events that produce Polar Cap Absorption (PCA) for understanding the chemical and dynamical behavior of the artificially-disturbed atmosphere, past PCA optical/infrared results are analyzed and intensity (and excitation temperature) of chemiluminous, photolytic, and fluorescent features predicted; additionally applications of ionosphere-emissions measurements of PCA to specific problems of optical and communications system degradation are reviewed. (GRA)

30872 (AD/A-006201) SIMULTANEOUS OBSERVATION OF TEC FROM NORTH AND SOUTH HEMISPHERE DURING THE 30TH JUNE 1973 SOLAR ECLIPSE. Interim Scientific Report No. 1, 1 May 1972–30 Apr 1973. Anastassiadis, M. A. (Athens Univ. (Greece)). Jun 1974. 9p. NTIS $3.25.

Simultaneous measurements of Total Electron Count (TEC) of the ionosphere from two magnetic conjugate points during the solar eclipse of 30th June 1973 were performed. The maximum change of TEC at Athens was ~7%. At Salisbury this change was more pronounced. The vertical incidence ionosonde measuring the critical freq. for the E, F1 and F2 layer showed no change in the maximum density of the layers. (GRA)

30873 (AD/A-006202) SOME RESULTS OF ELECTRON CONTENT MEASUREMENTS AT TORTOSA FROM THE INTELSAT II-F3 TRANSMISSIONS. Final Report, 1 Oct 1971–30 Sep 1974. Alberca, L. F.; Galdon, E. (Observatorio del Ebro, Tortosa (Spain)). 29 Nov 1974. 39p. NTIS $3.75.

From the signals of the Intelsat II-F3 satellite recorded at Tortosa, the total electron content and the slab-thickness of the ionosphere were obtained for the first six months of 1974, using a rotatory antenna. The ionosonde data of Tortosa (40° 49 minutes N, 0° 30 minutes E) and Arenosillo (37° 14 minutes N, 6° 43 minutes W) were used. The daily and seasonal variation were considered, and results were compared with the previous results obtained at Tortosa from the Explorer 22. By use of the TEC data of the sunrise period, the electron integrated production rate for an overhead sun (Q_0) was calculated. The variations obtained for (Q_0) are interpreted as variations on the (O)/(N2) concentration ratio. The results are discussed and compared with those of other authors. (GRA)

30874 (AD/A-007792) ATMOSPHERIC PHENOMENA. Final Technical Report, 1 Jul 1973–30 Jun 1974. Cartwright, D. C.; Winter, N. W.; Fiamengo, N. A. (Aerospace Corp., Los Angeles, Calif. (USA). Chemistry and Physics Lab.). 30 Jun 1974. Contract F04701-72-C-0073. 116p. NTIS $5.25.

The aim of this research is to provide a better understanding of processes taking place in normal and disturbed atmospheres. The Meinel band system of N_2^+, which is one of the strongest emissions in normal auroras, has been investigated in order to predict its intensity and altitude profile under auroral conditions. Accurate generalized valence bond calculations (GVB) have been carried out on the ground state of the nitrogen molecule for internuclear distances from 0.80 to 5.00 A. For comparative purposes, corresponding Hartree–Fock (HF) and valence bond calculations are also reported. The GVB orbitals were used to construct additional configurations for use in configuration interaction (CI) calculations. Detailed CI calculations have been carried out on all doublet electronic states of N_2^+ which can be formed from the first six ionic dissociation limits. Research has also been initiated on the formation of various triatomic molecules as a result of the deposition of energy into the atmosphere. In particular, the photochemistry and radiative properties of various NO_x compounds is under investigation. Improved virtual orbital (IVO), HF and CI calculations have been carried out for the 16 excited states of H_2O that can be formed by excitation from the two highest occupied orbitals of the ground state into a 3s or 3p Rydberg orbital. (GRA)

30875 (AD/A-008055) REPORT OF THE JOINT SATELLITE STUDIES GROUP, LANNION, JANUARY 1974. Final Report (Part 1). Papet-Lepine, J. (Centre National d'Etudes des Telecommunications (CNET), Centre de Recherches de Lannion, 22 (France)). 1 Jun 1974. 189p. NTIS $7.00.

Also pub. as Joint Satellite Studies Group, JSSG Report No. 5, Part 1. See also Addendum, AD/A–008056.

This report is a collection of a number of papers written by members of the Joint Satellite Studies Group. The bulk of the papers are concerned with total ionospheric electron content and satellite scintillation. A number of papers describe new equipment that has been developed by the members. (GRA)

30876 (AD/A-008056) ADDENDUM TO REPORT OF THE JOINT SATELLITE STUDIES GROUP, LANNION—JANUARY 1974. Final Report. Papet-Lepine, J. (Centre National d'Etudes des Telecommunications (CNET), Centre de Recherches de Lannion, 22 (France)). 1 Jun 1974. 240p. NTIS $7.50.

Also published as Joint Satellite Studies Group, JSSG Report No. 5, Addendum. See also Part 1, AD–008055. Report on Minutes of the Technical Meeting of the Joint Satellite Studies Group (12th), Lannion, France, 28 Jan-3 Feb 1974.

This report is a collection of a number of papers written by numbers of the Joint Satellite Studies Group. The bulk of the papers are concerned with total ionospheric electron content and satellite scintillation. A number of papers describe new equipment that has been developed by the members. (GRA)

30877 (AD/A-008193) SATELLITE BEACON STUDIES. 1. Total Electron Content. 2. Scintillation Studies. 3. Programming. Vesprini, R. L.; Martin, E.; Cantor, C.; Hagan, M. P. (Emmanuel Coll., Boston, Mass. (USA)). Nov 1974. Contract F19628-72-C-0305. 60p. NTIS $4.25.

This report provides information on (1) Total Electron Content (TEC) studies and their relationship to magnetic disturbances; (2) incidence of, and intensity of scintillations, as studied through indices; (3) programming techniques for handling scintillation indices. (GRA)

30878 (COM-74-50087-355/SL) IONOSPHERIC DATA. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Mar 1974. 126p. (NOAA-ISPOA-FA–355). Paper Copy Available from National Climatic Center, Federal Building, Asheville, N. C. 28801. Attn: Publications. $10.00/Year, $1.00/Copy.

The report contains monthly medians only for the same month the publication is issued. Also published are detailed data for the same month from an exemplary station, Wallops Island (Washington), including daily–hourly values of all characteristics, f-plots for Regular World Days, and an N(h) contour graph. As timely information, there is included selected ionospheric data for a Retrospective World Interval, when appropriate. Also given is information on ionospheric data recently received at World Data Center A for Solar-Terrestrial Physics and other information on availability of data from the WDC's. (GRA)

30879 (COM-75-10199) A 1964 DIGITAL DATA BASE FOR IONOSPHERIC MODELING. Part B. Incoherent Scatter Radar Results. Technical Memo. Lerfald, G. M.; Jurgens, R. B. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Space Environment Lab.). Oct 1974. 41p. (NOAA-TM-ERL-SEL–36). NTIS $3.75.

Prepared in cooperation with Environmental Protection Agency, Research Triangle Park, N. C. Div. of Meteorology.

The Millstone Hill (Massachusetts) Thomson scatter results for March, April, June, September, and December of 1964 are assembled in digital form. These digital results are archived on magnetic tape. The density and temperature profiles extend from 90 to 1000 km. The profile results are digitized as observed over the height range from 200 km to 700 km. Monthly mean values are introduced, along with a model for the underlying ionization, to extend the lower portion of the density profiles. An exponential extrapolation extends the density profiles at the higher heights. The electron and ion temperature profiles are extended to lower and higher heights, to be consistent with the neutral atmosphere as given by the model of Jacchia. (GRA)

30880 (COM-75-10217) A SEMI-AUTOMATED SYSTEM FOR TRUE-HEIGHT ANALYSIS OF FILM IONOGRAMS. Part 2. Converting from Hand to Machine Methods. Technical Memo. Goe, G.; Lerfald, G. M.; Jurgens, R. B. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Space Environment Lab.). Oct 1974. 33p. (NOAA-TM-ERL-SEL–37). NTIS $3.75.

Prepared by Environmental Protection Agency, Research Triangle Park, N. C. Div. of Meteorology.

An analysis system that automates many of the steps required to obtain electron density versus true height profiles from film ionogram data was developed and used. The semi-automated system retains the judgement and pattern recognition capabilities of trained operators to select and identify the ionogram features of interest when the digitizing is done directly from a projected film image. When hand tracings are prepared in advance, the system can be used in a fully automatic mode. In either case, however, automatic data processing techniques perform essentially all other functions. (GRA)

30881 (COM-75-10502) THEORY OF ION COLLECTION IN THE D REGION BY A RAPIDLY MOVING BLUNT PROBE OR MASS SPECTROMETER. Final Technical Report. Parker, L. W. (Mount Auburn Research Associates, Inc., Newton Upper Falls, Mass. (USA)). Jul 1974. 122p. (AL-10). NTIS $5.25.

The theory of ion collection at the center of a moving electrically charged blunt-electrode (probe) in the ionospheric D region is considered at high velocities such that the boundary layer is thin. The stagnation-point boundary-layer analysis of Sonin (1967) is reviewed, where diffusion, mobility, and convection are coupled within the thin boundary layer at infinite Debye length. Mass spectrometer flights are analyzed, and a negative-ion measurement is interpreted. (GRA)

30882 OPTICAL CHARACTERISTICS OF THE MESOPAUSE AND THE LOWER THERMOSPHERE ON THE NIGHTSIDE OF THE EARTH. Buznikov, A. A.; Kondrat'ev, K. Ya.; Lazarev, A. I.; Smoktii, O. I. (Leningrad Univ.). pp 77-80 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The paper describes and discusses observations made by cosmonauts of a layer near the mesopause which can cause an apparent change of color and brilliance of stars and planets. They may be explained by an enhanced concentration of aerosol particles near the mesopause at the time. (auth)

30883 PERIODIC OSCILLATIONS IN STRATOSPHERE AND MESOSPHERE. Cole, A. E. (Air Force Cambridge Research Labs., Bedford, MA). pp 173-180 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Periodic fluctuations in the annual temperature and density distributions based on rocket observations at heights between 30 and 90 km are presented in terms of amplitude and phase as a function of height and latitude. The amplitudes of the semi-annual components, noted in previous analyses below 80 km, in arctic and subarctic regions are markedly reduced if the analyses are based on monthly medians rather than monthly means. This is due to the sporadic occurrence of stratospheric and mesospheric warmings during winter. The level of the minimum variations in the annual temperature component at a given latitude ranges in height from 70 km near 80°N to 35 km near the equator. This level of minimum variability coincides with the level where a six-month change in phase occurs in the annual oscillations. The amplitudes of the annual temperature component are largest, nearly 50 K, near 90 km in polar regions and smallest in the tropics. The amplitudes of the semi-annual components of temperature generally are largest at the levels where the annual component is smallest. Amplitudes of the annual density oscillations increase with height and latitude reaching a maximum in the mesosphere near 70 km in June in polar regions. The semi-annual components of density are of minor importance at mid and high altitudes but account for the major portion of the variability above 45 km in the tropics and subtropics. (auth)

30884 EIGHT-HOURLY (TER-DIURNAL) COMPONENT OF ATMOSPHERIC TIDES. Glass, M.; Fellous, J. L. (Centre National d'Etudes Telecommunications, Issy-les-Moulineaux, France). pp 191-197 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The excitation of the atmospheric diurnal, semi-diurnal and ter-diurnal (eight-hourly) tides by the solar heating of ozone has been theoretically studied. The vertical structure of the tides in the lower thermosphere predicted by these computations, and their seasonal variations, have been compared with the data available from the Garchy meteor radar. The particular case of the ter-diurnal tide is examined and an attempt is made to explain the discrepancy between theoretical predictions and experimental results as a consequence of a non-linear interaction between the semi-diurnal and the diurnal tides. (auth)

30885 SOME RESULTS ON THE DAYTIME MEASUREMENT OF TEMPERATURE AND WIND IN THE MESOSPHERE AND LOWER THERMOSPHERE. Butko, A. S.; Ivanova, I. N.; Kokin, G. A.; Kuminov, A. A. (Hydrometeorological Service, Moscow). pp 199-201 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Temperature and wind observations made aboard three rockets launched from Volgograd during 12 June 1973 are reported. From 80 to 105 km altitude the temperature was between 150° and 250°K; above ~105 km it increased markedly with increasing height, especially during the evening launch when a temperature of 550°K was recorded at ~110 km. Winds were typically 100 m s^{-1} and variable in direction. The effects of diurnal and semi-diurnal atmospheric tides are mentioned. (auth)

30886 LOCAL COMPOSITION CHANGES IN THE THERMOSPHERE AT HIGH LATITUDES DURING MODERATE GEOMAGNETIC CONDITIONS. Wul-Mathies, C.; Blum, P.; Trinks, H. (Univ., Bonn). pp 203-207 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Mass spectroscopic measurements of Ar, N_2, O and He made by the satellite ESRO 4 in the polar regions have shown localized deviations from their unperturbed density ratios. The disturbances are marked mainly by a considerable enhancement of the number densities of argon and molecular nitrogen, while those of helium and atomic oxygen are only slightly changed. The time and space behaviors of several of these occurrences have been analysed. The limited extent and lifetime of these conditions are clearly shown by the analysis of the data. (auth)

30887 INTERPRETATION OF LOCAL THERMOSPHERIC DISTURBANCES OF COMPOSITION OBSERVED BY ESRO 4 IN THE POLAR REGION. Blum, P. W.; Wulf-Mathies, C.; Trinks, H. (Univ., Bonn). pp 209-214 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

During weak and moderate geomagnetic disturbances compositional changes of the thermosphere in the height region between 250 and 300 km have been frequently observed by the ESRO 4 mass spectrometer. These events were limited to a narrow band of latitudes and generally lasted several hours. The main changes in composition were a strong increase in the number density of argon, a considerable increase in the molecular nitrogen density and a decrease in the helium density. The atomic oxygen density changed only insignificantly. A simple model is suggested that explains these compositional changes in terms of a heating of the thermosphere between 75 and 150°K and a height increase of the turbopause level by 1.5 to 5 km. (auth)

30888 OBSERVATIONS DURING A MAGNETIC STORM IN LATE OCTOBER 1973. Proelss, G. W.; Fricke, K. H.; von Zahn, U. (Univ., Bonn). pp 215-220 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Data obtained by the gas analyser aboard ESRO 4 during a magnetic storm in late October 1973 are presented. Prominent features are a large increase in the nitrogen density and a simultaneous decrease in the oxygen density. Although most pronounced in the higher latitude region where most of the energy injection occurs, the disturbance expands to lower latitudes during the course of the storm. Geomagnetic control and an uneven distribution of the energy input cause a considerable longitudinal asymmetry in the atmospheric response. The ionosphere reacts to the disturbance with a decrease in plasma density. The close connection between the two phenomena may be used better to define the temporal and spatial development of storm effects. (auth)

30889 VARIATIONS OF ATOMIC OXYGEN DENSITIES IN THE THERMOSPHERE. Schmidtke, G.; Muenther, C.; Rawer, K. (Fraunhofer Gesellschaft, Freiburg i. B.). pp 221-225 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

From December 1972 through August 1973 the sunrise/sunset occulation method was used aboard the satellite AEROS yielding nearly 3000 extinction curves for two selected solar emission lines. From a part of these data density profiles of atomic oxygen have been derived and their variations determined. (auth)

30890 NEUTRAL ATMOSPHERE VARIATIONS ACCORDING TO MEASUREMENTS MADE IN TROPICAL AND MIDDLE LATITUDES. Mikhnevich, V. V.; Pokhunkov, A. A.; Golubev, E. N.;

Ivanov, Yu. F.; Gorbunov, S. V. (Hydrometeorological Service, Moscow). pp 227-231 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Experimental data on the variations of neutral atmospheric composition, pressure and temperature obtained by MR-12 meteorological rockets launched from a research ship in summer 1973 at equatorial latitudes are compared with those obtained on the same days from the rocket site Volgograd. The ratio O_2/N_2 lies within ±25% of the Jacchia 1971 model values. All experimental data of the ratio O/O_2 lie below the corresponding model values. (auth)

30891 SIMULTANEOUS ROCKET MEASUREMENTS OF STRUCTURE PARAMETERS OF POLAR THERMOSPHERE AND AURORAL RADIATION. Zhuchenko, Yu. M.; Lipovetskii, V. A.; Novikov, L. S.; Tulinov, V. F.; Tulinov, G. F.; Feigin, V. M. (Hydrometeorological Service, Moscow). pp 233-236 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Neutral temperature and pressure observations at up to 180 km latitude above Heiss Island in March 1972 are discussed, as are simultaneous observations of the fluxes of energetic electrons (both 0.5 to 50 keV and ≧ 40 keV). Increases of the former are correlated with increases of the latter. The heating rate of the polar thermosphere may reach values of 25°K/hour near 150 km altitude due to the precipitation of 0.5 to 50 keV electrons during a moderate geomagnetic disturbance. (auth)

30892 MEASUREMENT OF NITRIC OXIDE DISTRIBUTION IN THE UPPER ATMOSPHERE. Tohmatsu, T.; Iwagami, N. (Tokyo Univ.). pp 241-245 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

An ultraviolet photometer, designed to be used on board small sounding rockets for measurements of the nitric oxide γ-bands in the day airglow, was launched on 19 August 1973 at Uchinoura, Japan. The density of neutral nitric oxide was deduced in the altitude range between 80 and 120 km. The aeronomic implication of the present experimental results is discussed in terms of the currently accepted photochemical-dynamical model of the upper atmosphere. (auth)

30893 EXPERIMENTAL DATA ON ATOMIC NITROGEN VARIATIONS IN THE UPPER ATMOSPHERE AFTER SUNSET. Balabanova, V. N.; Bychkova, K. D.; Lebedinets, V. N.; Martynenko, V. P.; Pokhunkov, A. A. (Hydrometeorological Service, Moscow). pp 247-249 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Values of atomic nitrogen concentration at 140 km altitude after sunset (zenith angles 100°–150°) obtained at middle latitudes by the ethylene luminous cloud method indicate that the mechanism of N disappearance at night is more complex than predicted by theoretical calculations. It is shown that 1 h 15 min after sunset the N concentration at 140 km is 10^{10} atom cm^{-3} and close to the daytime N concentration. Eight hours after sunset the N concentration has considerably decreased and is not observed by the luminous cloud method nor by mass spectrometers. It is concluded that shortly after sunset either there are reasonably intense sources of atomic nitrogen or the loss processes are rather slow. (auth)

30894 FIRST RESULTS OF 6300 A NIGHTGLOW MEASUREMENTS ABOARD A ROCKET LAUNCHED FROM NATAL, BRAZIL. Sahai, Y. (Instituto de Pesquisas Espacisais, Sao Jose dos Campos, Brazil); Drescher, A.; Lauche, H.; Teixeira, N. R. pp 251-255 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The OI 6300 Å nightglow emission was observed by a rocket-borne photometer launched from Natal (5.9°S 35.2°W), Brazil. The preliminary height profiles of the volume emission rate are presented. These profiles are compared with the calculated emission profile using ionosonde data from Natal and a model atmosphere. (auth)

30895 PRELIMINARY RESULTS OF OBSERVATIONS OF ATMOSPHERIC ULTRAVIOLET TWILIGHT EMISSIONS BY THE TD1-A SATELLITE. Monfils, A.; Gerard, J. C. (Univ., Liege). pp 257-262 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Preliminary data collected by the UV telescope on board the ESRO TD1-A satellite in its winter spinning mode are described and analysed. They consist of angular scans parallel to the terminator plane, near the dusk meridian, in four ultraviolet channels covering the spectral range 1350–2200 Å. The main twilight emissions are identified as well as the altitude-latitude intensity dependence. The Mg II resonance doublet near 2800 Å appears to be present in one of the channels, in agreement with previous high altitude observations. The altitude distribution of magnesium ions obtained by comparison between the northern and southern scans at a given latitude is illustrated. (auth)

30896 PRELIMINARY RESULTS ON SUPRATHERMAL H AND He ATOMS IN THE MIDDLE LATITUDES LOWER THERMOSPHERE DURING A MAGNETIC DISTURBANCE. Martynkevich, G. M. (Hydrometeorological Service, Moscow). pp 263-265 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

An MR-12 rocket, launched from Volgograd on 12 June 1973 during the recovery phase of a geomagnetic storm, carried a time-of-flight mass spectrometer for measurements of neutrals and a double-mode radiofrequency mass spectrometer for measurement of neutrals and positive ions. Suprathermal neutral particles, such as H and He atoms, with energies up to 25 eV were detected. High concentrations of thermalized H and He atoms were also recorded. The results of the measurements are discussed and compared with data obtained earlier by other authors. (auth)

30897 WINDS AND DIFFUSION IN THE UPPER ATMOSPHERE OBSERVED BY A SODIUM VAPOR TRAIL RELEASED OVER THUMBA. Desai, J. N.; Bhavsar, P. D.; Raghavarao, R.; Narayanan, M. S. (Physical Research Lab., Ahmedabad, India). pp 267-271 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

A sodium vapour trail was released at evening twilight on 19 April 1971 from Thumba, India (8°32′N 76°51′E) over an altitude range of 80–180 km. The trail was photographed from two stations using calibrated films. Winds were determined from 80 to 160 km and the diffusion coefficient at 125 km. The turbopause height was observed to be at 104 ± 1 km. Strong wind shear was observed between 105–110 km. Above 120 km the mean zonal flow was eastwards and the mean meridional flow was southwards, with wind speeds exceeding 100 m s^{-1}. (auth)

30898 CRITICAL EVALUATION OF THE OGO 6 HELIUM MODEL. Keating, G. M. (Langley Research Center, Hampton, VA); Prior, E. J.; McDougal, D. S.; Nicholson, J. III. pp 273-278 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Drag measurements of the Explorer 19, 24 and 39 satellites near 900 km altitude and over the solar cycle through 1973, have been critically compared with the recent thermospheric model based on OGO 6 neutral mass spectrometer measurements from mid-1969 to early 1971. The drag data clearly indicate both a significantly greater exospheric helium and temperature variation over the 11-year solar cycle than given in the model. Assuming the very large pole-to-pole temperature variation (~400°K) given in the OGO model, the drag data indicate that the winter to summer pole helium concentration ratio is 21 at 450 km compared with the value of 12 indicated by the OGO model. This difference may result from an underestimate of the helium variation in the OGO model or a polar temperature variation somewhat less than that given in the OGO model but significantly larger than that given in the CIRA 72 model. This study gives the first evidence from drag data of a helium diurnal variation near the turbopause with a morning maximum which agrees in phase but not amplitude with that given in the OGO 6 model. (auth)

30899 ANNUAL AND SEMIANNUAL DENSITY VARIATIONS IN THE EARTH'S EXOSPHERE. Wul-Mathies, C. (Univ., Bonn); Prior, E. J.; Keating, G. M. pp 279-285 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Drag data of the three balloon satellites Explorer 19, 24 and 39 were analyzed for the period 1967–1970 in order to obtain information on the semiannual density variation in the lower

exosphere. The observed semiannual effect was decomposed into Fourier terms. The annual and semiannual components are sufficient to represent the observations. The phase of the semiannual component is relatively constant, peaking on the average on 11 April and 10 October. The phase of the annual component varies strongly. Its maxima occur between October and March. The semiannual amplitudes change by a factor of more than two over the period of analysis. The annual amplitudes are much less variable. Hence the variation of the amplitude of the semiannual effect is mainly due to changes of the amplitude of the semiannual component. Comparisons between the observations and predictions of the OGO 6 and CIRA 72 models showed large discrepancies in phases and amplitudes. The semiannual effect as predicted by the OGO 6 model peaks generally 14 days earlier than the observations. (auth)

30900 O TO N_2 DENSITY RATIO IN THE THERMOSPHERE DERIVED FROM ESRO 4 DATA. Koehnlein, W.; Trinks, H.; Volland, H. (Univ., Bonn). pp 287-291 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The O/N_2 density ratio as obtained from the ESRO 4 gas analyser is investigated for magnetically quiet conditions during December 1972 to December 1973. Constructing a global model by use of a spherical harmonic expansion, the variations of O/N_2 are analysed for annual, semiannual (both symmetric and asymmetric) and diurnal terms near 250 km altitude. In agreement with the extrapolated version of the OGO 6 model, the O/N_2 number density ratio peaks early in the morning (around 4 am). In the northern hemisphere the O/N_2 ratio exhibits a winter maximum and a summer minimum, with analogous results in the southern hemisphere. (auth)

30901 INTERCOMPARISON OF DIFFERENT MEASURING TECHNIQUES IN THE UPPER ATMOSPHERE: THE INTERNATIONAL REFERENCE IONOSPHERE. Rawer, K. (Fraunhofer-Gesellschaft, Freiburg i. B.). pp 295-320 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

In order to establish typical profiles of the most important parameters of the ionospheric plasma, it has been agreed to rely upon measured data. A review of the different data sources has revealed that the amount of significant observations with certain techniques is rather scarce. Only a few techniques have produced a large amount of data; these do not, however, provide a full set of basic information. Also results obtained with different techniques are sometimes divergent. By discussion with many specialists during the past years, a policy for attributing priority to certain techniques has been established. Tentative tables have been produced in order to have profiles for mainly three latitudes from the lower D region up to an altitude of about 1000–2000 km. The profile data should now be checked with results obtained by different techniques, including those which have not been used when establishing the tables. (auth)

30902 COMPARISON BETWEEN ELECTRON DENSITY AND TEMPERATURE DURING DAYTIME. Spenner, K.; Wolf, H. (Fraunhofer-Gesellschaft, Freiburg i. B.). pp 321-325 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Observations with a planar Retarding Potential Analyser aboard the satellite AEROS-A show a relationship between simultaneously measured electron density and temperature values which, at low latitudes, appears as a good negative correlation. Empirical laws are derived for five altitude ranges between 230 and 850 km and different invariant latitude ranges. The standard deviation of the individual measurements at fixed local time is quite small at low latitudes and increases towards higher latitudes. (auth)

30903 DAYTIME ELECTRON DENSITY PROFILES OF THE E AND F1 REGION. Fukao, S. (Kyoto Univ.); Maeda, K. pp 327-333 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Based on rocket experiments on the electron density profiles of the E and F1 regions, an attempt is made to construct theoretically the overall profile of the mid-latitude E and F1 regions around noon in each season and for any solar activity. The atmospheric model used in the theoretical calculation is based on the actual rocket data as far as possible. The contribution to electron production of all solar radiation fluxes in the wavelength range 1037.6–1 Å is studied with the aid of recent data of the absorption and the photoionization cross sections. Theoretical curves thus obtained are corrected so that the maximum density at the E region coincides with the value deduced from the ionosonde observation. The constructed profiles show fairly good agreement with the experimental results obtained by rockets. (auth)

30904 ABSOLUTE EUV PHOTON FLUXES OF AERONOMIC INTEREST. Schmidtke, G.; Rawer, K.; Fischer, W.; Rebstock, C. (Fraunhofer-Gesellschaft, Freiburg i.B.). pp 345-349 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

During the mission of the satellite AEROS-A (18 December 1972–22 August 1973) an EUV spectrometer monitored the solar photon fluxes in the wavelength range from 106 to 16 nm. As a first result a table of absolute photon flux values, representative for 2 March 1973, 1430–1450 UT, is presented. (auth)

30905 MASS SPECTROMETER MEASUREMENTS OF THE F2 REGION ION COMPOSITION FROM THE SATELLITE COSMOS 274. Romanovskii, Yu. A.; Katyushina, V. V.; Istomin, V. G. (Hydrometeorological Service, Moscow). pp 351-356 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Data from mass spectrometer measurements of the ion composition of the F2 region aboard the satellite Cosmos 274 are reported. The ions H^+, N^+, O^+, N_2^+, NO^+ and O_2^+ were regularly recorded. In the quiet ionosphere the troughs of atomic ions are found in the dawn sub-auroral region (e.g. the "main trough") and in mid- and low latitudes in the northern hemisphere at post-sunset hours. In troughs the relative concentration of molecular ions is increased. The molecular ion distribution near the F layer peak is presumably controlled by photochemical and O^+ dynamic processes. In storm periods the troughs of atomic ions deepened and new troughs appeared; both absolute and relative concentrations of molecular ions in the F2 region increased. A dawn-dusk asymmetry of the storm-time ionosphere in response to the dawn-dusk asymmetry of the neutral atmosphere is reported. (auth)

30906 INTENSITIES OF 6300 A, 5577 A, AND 5200 A EMISSIONS FROM ION COMPOSITION MEASUREMENTS IN THE F2 REGION. Vlasov, M. N.; Romanovskii, Yu. A. (Hydrometeorological Service, Moscow). pp 357-361 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

In order to appreciate the contributions of the dissociative recombination of molecular ions to the emissions of atomic oxygen (λ 6300 Å, 5577 Å) and atomic nitrogen (λ 5200 Å) in the night and pre-dawn F2 region of the ionosphere the ion composition data from the satellite Cosmos 274 were used. The $[O(^1D)]$ concentrations calculated from the satellite ion data are consistent with the $[O(^1D)]$ values calculated from rocket measurements results. It is found that the pre-dawn increase of O_2^+ ions in the subauroral region can account for pre-dawn enhancement of the red emission. The principal features of the excited species during disturbed conditions after sunset are found and presented. (auth)

30907 QUIET AND DISTURBED ELECTRON TEMPERATURE AND DENSITY AT DIFFERENT LATITUDES DURING DAYTIME. Spenner, K. (Fraunhofer-Gesellschaft, Freiburg i. B.). pp 363-368 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The influence of geomagnetic disturbance on the electron temperature and density in the ionosphere, measured on board the AEROS satellite has been studied around 15 h LT. The global behaviour strongly depends on the geomagnetic latitude. In the equatorial region a good correlation with changing Kp values could be established. Some typical features of disturbed conditions are described. (auth)

30908 ELECTRON TEMPERATURE VARIATIONS AT 100 TO 200 km FROM PROBE MEASUREMENTS. Chasovitin, Yu. K.; Klyueva, N. M. (Hydrometeorological Service, Moscow). pp 369-377 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Results of seventy-five rocket launches for electron temperature (T_e) measurements at altitudes 100–200 km in middle and high latitudes are analysed. A preliminary empirical model is constructed showing electron temperature variations with solar

zenith angle in middle latitudes. The dependence of T_e on solar and geomagnetic activity is considered and it is shown that in middle latitudes this dependence is rather weak. It should be noted that electron temperature variations with varying solar and geomagnetic activity can be of a different character for the different sites situated in different geographic zones. At high latitudes T_e is higher by day than by night normally. (auth)

30909 VERY LOW ENERGY ELECTRON SPECTRA IN THE AURORAL ZONE. Dumbs, A.; Noack, W. (Fraunhofer-Gesellschaft, Freiburg i.B.). pp 379-384 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Aboard a Zenit-rocket launched at 1420 UT on 13 December 1972 from Andoya (Norway) was a combined Retarding Potential and Electrostatic Analyser (RPEA). The new experiment was developed to measure thermal and suprathermal electrons up to 30 eV. The rocket was fired during a magnetic disturbance of 200 γ with a solar zenith angle of about 93°. In the altitude range from 100 km up to the apogee of the rocket at 144 km good electron spectra are available. An electron flux maximum appeared at or above 30 eV; Nagy and Banks in 1970 predicted a maximum around 25 eV for higher altitudes and middle latitudes. Temperature, density and suprathermal flux profiles are discussed. (auth)

30910 FORMATION OF IONIZATION LEDGES IN THE EQUATORIAL TOPSIDE IONOSPHERE. Raghavarao, R.; Sivaraman, M. R. (Physical Research Lab., Ahmedabad, India). pp 385-391 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Topside ionograms recorded at Ahmedabad from the ISIS satellites reveal cusps, a manifestation of the formation of an ionization ledge in the equatorial topside ionosphere. The ledge is found to be along the earth's magnetic field line and its maximum is usually over the magnetic equator. Sometimes it develops two maxima located on either side of the magnetic equator. Evidence is presented that the ledge can form along a field line other than the field line passing through the ionization peaks of the equatorial anomaly. Field-aligned enhancements in the neutral densities are envisaged for the formation of the ionization ledges. The enhancements in neutral density in turn inhibit the plasma flow along the field line and thus are primarily responsible for the enhancement of ionization along a particular field line over the magnetic equator. The more frequent occurrence of ledge in the solar minimum period is explained on the basis of the higher crest-to-trough ratio of the ionization density in the equatorial anomaly during solar minimum than during solar maximum. (auth)

30911 MEASUREMENTS OF IONOSPHERIC PARAMETERS AT 100 TO 170 km DURING A TOTAL SOLAR ECLIPSE. Danilov, A. D.; Ivanov, U. F.; Ivano-Kholodny, G. S.; Kazatchevskaya, T. V.; Semenov, V. K.; Selantiev, V. V.; Chasovitin, Yu. F.; Khryukin, V. G. (Hydrometeorological Service, Moscow). pp 393-397 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

During the total solar eclipse of 30 June 1973 and on two control days, measurements of electron density and temperature, ion concentration, EUV radiation and corpuscular fluxes were made using MR12 rockets launched from a ship positioned to the west of the Cape Verde Islands. From these observations the ionization rates and effective recombination coefficients have been calculated as functions of height from 100 to 170 km. The results obtained are self-consistent. (auth)

30912 THEORETICAL INTERPRETATION OF GYROHARMONIC RESONANCES OBSERVED DURING ROCKET EXPERIMENTS. Bitoun, J. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). pp 399-404 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Resonances of the ionospheric plasma excited by the relaxation sounder aboard French rockets EIDI have been studied, in greater detail than by the usual topside sounders, by the use of a receiver providing the waveforms and amplitudes of the observed signals. Beats are observed at harmonics of the gyrofrequency f_B and, particularly, at $3f_B$. In order to explain this phenomenon theoretically, ray-tracing is carried out using the dispersion equation for electrostatic waves in a hot magnetoplasma. The transmitted waves are shown to travel almost parallel to the earth's magnetic field whose gradient is responsible for their reflection back to the spacecraft antenna. Moreover, by the saddle-point method analytic evaluation yields the relative intensity of the received wave electric fields as a function of time, and the wave damping is determined all along the paths. (auth)

30913 VELOCITIES OF SMALL AND MEDIUM SCALE IONOSPHERIC IRREGULARITIES DEDUCED FROM DOPPLER AND ARRIVAL ANGLE MEASUREMENTS. Bibl, K. (Lowell Technological Inst. Research Foundation, MA); Pfister, W.; Reinisch, B. W.; Sales, G. S. pp 405-411 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Spectral analysis of the complex amplitudes of ionospheric radio echoes received at three (or more) spaced antennas shows the number and extent of simultaneously existing reflection areas in the ionosphere. Motions of the reflecting ionization produce Doppler shifts that in general are different for different look angles. Analysis of E and F region data frequently shows narrow horizontally extended reflection areas that move to different positions in successive observation periods. The motion of this medium scale structure has a period of about 12 minutes in an example discussed. The observed Doppler shifts, however, are mainly controlled by the motion of small scale irregularities (hundreds of meters) that move with velocities of up to 200 m s^{-1} essentially independently of the motion of the medium scale structure. Assuming the velocity field to be constant over an individual reflection area we calculate the three-dimensional velocity vector from the spatial Doppler measurements. A sporadic E layer that formed after a chemical release from a rocket at Eglin, Florida, was monitored: the velocity of the small scale structure was independent of the direction of motion of the medium scale structure and the vertical velocity was of the order of a few meters per second. (auth)

30914 ANALYSIS OF SCINTILLATION PHENOMENA PRODUCED OVER TUCUMAN, FOR THE 1965–1968 PERIOD. Rios, V. H.; Sauvage, A. M.; Manzano, J. R. (Universidad Nacional, Tucuman, Argentina). pp 413-418 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The 1964 Beacon BE-B satellite scintillation data from 1965 to 1968, over Tucumán (dip angle −22.1°), have been analysed. The two-hourly averaged diurnal variation of the percentage of occurrence of scintillation for equinoxes and solstices shows: the existence of scintillation over Tucumán at all hours; two well separated maxima at local night time that could be connected with sunrise and sunset atmospheric gravity waves; a similar local time variation for both scintillation occurrence and geomagnetic activity, indicating a possible common modulation mechanism for them; agreement with Haifa data and a clear difference from those of Huancayo and Ghana, suggesting a narrow belt around the dip equator where the scintillation activity is only nocturnal and related to the diurnal behaviour of the ionospheric equatorial (Appleton) anomaly of the F region; maximum occurrence of scintillation during the equinoxes and minimum during the winters, which could also be related to the behaviour of the equatorial anomaly. (auth)

30915 REFRACTION OF VLF WAVES BY A SPORADIC E LAYER. Usher, R. A.; Rycroft, M. J. (Univ. of Southampton, Eng.). pp 419-424 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The refraction by a sporadic E layer, of downcoming VLF chorus signals at 2.9 and 3.5 kHz has been studied in detail using observations made aboard the Petrel rocket P47H. Considering propagation in the magnetic meridian, an analysis of the wave normal directions shows that the constant electron density contours are horizontal below 103 km altitude, but make angles of up to ~60° with the horizontal in the sporadic E layer. Above the sporadic E layer, the tilt of the ionosphere is ~30°; it is in such a direction that the height at which a certain electron density exists is greater to the North (polewards) than to the South. Propagation off the magnetic meridian is also considered; it is shown that this does not lead to more plausible models being obtained. The ray direction for downcoming chorus signals is within 10° of being field-aligned above the sporadic E layer; in the layer it is bent so that at 104 km and below it is essentially vertical. It is expected that such waves excite the earth-ionosphere waveguide very effectively. (auth)

30916 RIGOROUS COMPUTATION OF THE RADIATION FIELDS OF VLF/ELF AERIALS. Nunn, D. (King's Coll., London). pp 425-430 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116--.

This work computes the full radiation field of a VLF/ELF antenna located on the earth's surface underneath an ionosphere consisting of horizontal plasma slabs threaded by a magnetic field inclined to the vertical. Planar geometry is assumed but otherwise the computation is rigorously full wave. The technique consists of expanding the source fields as 3000 plane electromagnetic waves and following each of these through the plasma slab system. The final field at any point is derived from the appropriate sum of plane wave solutions. Computations are made in connection with proposed 1.4 kHz transmissions to GEOS, and also for an NAA type transmitter. (auth)

30917 ELECTRIC FIELD AND PLASMA MEASUREMENTS IN THE AURORAL IONOSPHERE PRIOR TO A MAGNETIC SUBSTORM. Fahlson, U. (Royal Inst. of Tech., Stockholm); Faelthammar, C. G.; Pedersen, A. pp 471-475 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116--.

Electric field and Langmuir probe experiments flown on a rocket from Esrange prior to a substorm show characteristic changes of the electric field and ionospheric plasma in connection with the appearance of weak auroral activity overhead. The electric field, which is initially about 40 mVm^{-1} and northerly, decreases to 20 mVm^{-1} and turns temporarily eastward by 15°. Simultaneously plasma density and temperature increases are observed. (auth)

30918 SIMULTANEOUS OBSERVATIONS OF THE MOTION OF LARGE-SCALE ELECTRON DENSITY IRREGULARITIES AND OF IONOSPHERIC ELECTRIC FIELD NEAR THE POLAR BORDER OF THE SOUTHERN AURORAL ZONE. Sylvain, M. (Groupe de Recherches Ionospheriques, St-Maur, France); Roux, D.; Berthelier, A.; Guerin, C.; Mozer, F. S. pp 477-483 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116--.

Topside ionograms from ISIS 2 spacecraft received at Dumont d'Urville antarctic station (66° S 140° E) on 23 January 1973 between 0737 and 0753 UT and bottomside ionograms made at the station the same day between 0600 and 0900 UT have been investigated simultaneously. The satellite gives an instantaneous picture of spatial variations of the topside ionosphere whereas bottomside soundings describe the temporal evolution. The good agreement between the two descriptions at the maximum density level is interpreted by electron density irregularities drifting towards the pole, and their apparent velocity is computed. A two-dimensional model of the electron isodensities for the time when the satellite is above the station has been built up. Simultaneous balloon measurements of the ionospheric electric field by the double probe technique give a drift velocity $(E \times B)/B^2$ whose amplitude and direction are in good agreement with the preceding results. A more precise analysis gives some information about the orientation of the irregularities. (auth)

30919 ZARNITZA ROCKET EXPERIMENT ON ELECTRON INJECTION. Cambou, F. (Univ., Toulouse); Dokoukine, V. S.; Ivchenko, V. N.; Managadze, G. G.; Migulin, V. V.; Nazarenko, O. K.; Nesmyanovich, A. T.; Pyatsi, A. Kh.; Sagdeev, R. Z.; Zhulin, I. A. pp 491-500 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116--.

The Zarnitza experiment on electron injection into the ionosphere was performed from a rocket launched in the Volgograd region ($L \sim 2$), on 29 May 1973. This experiment confirms the possibility of injecting an intense electron beam with an energy of several keV into the ionosphere without using an active charge neutralization system. Optical ground observations and radar measurements were made during the flight and the results of these observations are discussed. (auth)

30920 EFFECTS OF GEOMAGNETIC SUBSTORMS IN ELECTRON CONCENTRATION OF F REGION AT NIGHT ON OCTOBER 29-30, 1973. Gogosheva, T. N.; Gogoshev, M. M.; Serafimov, K. B.; Kazakov, L. M.; Koutiyev, I. G. (Central Lab. for Space Research, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 10, 1363-1366(1975).

The ionospheric changes compared to those in the geomagnetic field are analyzed, obtaining for the purpose the vertical distribution of the electron density for the considered night by means of the laminar method for the ordinary magnetic-ion component reflected in the F region. It was found that the ionospheric disturbance has an arranging effect on quasi-periodic variations and renders the variations in a calm period more regular, better defined, and more pronounced. It is deduced that all these variations are due to quasiperiodic changes in the intensity of the ring current running in the equatorial geomagnetic plane at a distance of 3 to 6 R_3. (JFP)

30921 DETERMINATION OF THE ELECTRON TEMPERATURE NEAR THE MAXIMUM OF THE IONOSPHERIC F-REGION FROM MEASUREMENTS OF RADIO WAVE ABSORPTION BY A2-METHOD. Benediktov, E. A.; Tolmacheva, A. V. (All Union Radio Physical Inst., Moscow). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 2, 200-206(1975). (In Russian).

The results of measurements of radio wave absorption in the ionosphere obtained by the radio astronomical method at the frequencies of 13 and 9 Mc/s in Gorki (φ = 56°N) in 1967 are used to find the electron temperature T_e near the maximum of the ionospheric F-region. The values of T_e were determined by comparing the estimated absorption values with the experimental ones. The mean values for winter and equinox at noon were within 1700 to 2100°. The diurnal variation of T_e at daytime hours on March 1967 is obtained. It was characterized by the rise in T_e from 1500° at 7 to 8 hours in the morning up to 2200 to 2400° at the near-midday time and by a rapid fall close to the evening. The possibilities and errors of determination of T_e according to the measurements of radio wave absorption by the method A2 are discussed. (auth)

30922 VARIATION IN THE ENERGY SPECTRA OF AURORAL ELECTRONS. Shumilov, O. I.; Driatskii, V. M.; Sergeev, V. A. Uch. Zap. Leningr. Gos. Univ., Ser. Fiz. Geol. Nauk; No. 24, 335-346(1974). (In Russian).

On comparing simultaneous recordings of the intensity of auroral displays, the auroral absorption and magnetic perturbations it is shown that the hardness of the electron energy spectrum in the energy interval from 1 to 40 kev increases over a broad range L near the auroral zone. On the average with an increase in the intensity of particle flux, for electrons with energies greater than 40 kev a softening of the energy spectrum is observed with an increase in intensity of emission. The opposite behavior of various parts of the energy spectrum as a function of the intensity of the outbreak apparently characterizes the processes of the acceleration and pitch-angular diffusion of electrons in the earth's magnetosphere. 5 figs. 14 refs. (SJR)

30923 FEATURES OF A PULSING, AURORAL ABSORPTION. Shumilov, O. I.; Driatskii, V. M.; Barmin, N. A.; Novikov, Yu. P. Uch. Zap. Leningr. Gos. Univ., Ser. Fiz. Geol. Nauk; No. 24, 347-354(1974). (In Russian).

With an extensive base of experimental material the study investigates a number of features of P-subtype of auroral absorption. A particular type of "day" absorption pulsation is isolated with a maximum in the appearance frequency in the region of local midday. Various physical mechanisms are discussed for generating the periodic variations in absorption. 5 figs. 11 refs. (SJR)

30924 MODULATION CHARACTER OF ELECTRON FLUX DURING OBSERVATION OF A P-SUBTYPE OF AURORAL ABSORPTION. Barmin, N. A.; Shumilov, O. I.; Driatskii, V. M. Uch. Zap. Leningr. Gos. Univ., Ser. Fiz. Geol. Nauk; No. 24, 355-364(1974). (In Russian).

Use is made of the frequency dependence (32 to 40 Mhertz) of the absorption during a P-subtype of auroral absorption (AA). By analyzing the daily course of the coefficient of the frequency dependence n for the pulsations and background on which the pulsations are superimposed it is possible to conclude that P-absorption is caused by modulation of the density (and not the energy) of the electron flux. In addition a smooth decrease of n is obtained on going from the night hours to the morning hours. This behavior indicates a gradual hardening of the intruding particles, and points to the existence of a large-scale electrical field in the magnetosphere. An analysis is presented of the possibility of the effect of errors in the rheometric method on the correctness of the conclusions which were made. 4 figs. 20 refs. (SJR)

30925 MAGNETICALLY ORDERED HEATING IN THE POLAR REGIONS OF THE THERMOSPHERE. Hinton, B. B. Ann Arbor, MI; Univ. of Michigan (1975). 206p. University Microfilms Order No. 75-20,367.

Thesis (Ph. D.).

Using data from the Neutral Atmosphere Composition Experiment on the OGO-6 Satellite, geomagnetically controlled perturbations of composition and temperature in the upper thermosphere are studied for magnetically quiet and, for the first time, ordinary days. Viewed with a horizontal resolution of about 2000 km the composition patterns are indicative of temperature changes of the order of 100 degrees in the vicinity of the magnetic polar regions. From the examination of data from individual orbits it is concluded

that the dominant process is vertical free convection driven by heating. It is assumed that the Navier-Stokes equations apply up to about 300 km altitude, the thermosphere is nearly in hydrostatic equilibrium and the dominance of molecular scale transport above 300 km insures nearly isothermal temperature profiles and diffusive equilibrium shaped constituent profiles up to 500 km, where the data are gathered. Based on these assumptions and scaling considerations two one-dimensional models are proposed. Several altitude profiles of heating are considered, but because of its probable resemblance to the actual profile one corresponding to joule heating is studied more extensively. Maps of the horizontal distribution of the column integrated energy input rate are produced for the first time from comprehensive global composition data. Also, global average input rates for this heating are obtained (relative to the adopted altitude profile). These are about 0.25 mWm^{-2} for quiet days and 0.50 mWm^{-2} for ordinary days. It follows that polar heating is extremely significant to global thermospheric structure on both ordinary and quiet days. (Diss. Abstr. Int., B)

30926 ION VELOCITY DISTRIBUTIONS IN THE AURORAL IONOSPHERE. St. Maurice, J. P. New Haven; Yale Univ. (1975). 250p. University Microfilms Order No. 75-27,109.

Thesis (Ph. D.).

There are regions in the weakly-ionized plasma of the lower ionosphere where conditions may be such as to drive the ion velocity distributions away from the Maxwellian form. Such conditions are encountered in auroral regions where strong perpendicular electric fields are present. Large neutral winds are also the cause for similarly distorted distributions. A relaxation model for collisions enables Boltzmann's equation to be solved exactly. For infrequent collisions and strong electric fields the ions are distributed over a torus in velocity space. As the collision frequency is increased, the ions distribute themselves on a portion of this torus. Similar distributions are expected for other models of ion–neutral interactions which may be physically more accurate than a relaxation model. In particular, resonant charge-exchange reactions, which are dominant for O^+ above 200 km, drive the ions to the same kind of non-Maxwellian distribution. A comparison with results obtained with a polarization model for collisions in the limit of small departures from a Maxwellian also shows this description to be qualitatively correct. Evidence has been found for the existence of non-Maxwellian velocity distributions in some of the volt–ampere characteristics obtained with the retarding potential analyser carried by Atmospheric Explorer C. The non-Maxwellian behavior was detected when the electric field strength was greater than 50 mV/m. For weaker electric field strengths the presence of non-Maxwellian distributions still affects the shape of the characteristics. Use of Maxwell distributions to fit the data results in values that are less accurate. Non-Maxwellian effects must be considered if an accurate value for the ion temperature is desired. (Diss. Abstr. Int., B)

30927 RELATIONSHIP OF SEASONAL BEHAVIORS OF IONOSPHERIC ABSORPTION AND WINDS IN THE HIGH ATMOSPHERE. Velinov, P. (Inst. of Geophysical, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 12, 1605-1608(1975).

An extension is made of a previous survey on the role of dynamic factors on the seasonal course of ionospheric absorption, regarding both height range and frequency range of the radiowaves. For this purpose data are adduced on the seasonal course of absorption of medium and long waves on different paths, so as to reveal regularities not only by ionospheric height but also at different latitudes. (JFP)

30928 CONTRIBUTION OF SOLAR X-RADIATION TO IONIZATION OF D REGION. Nestorov, G. T. (Inst. of Geophysical, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 12, 1609-1612(1975).

A contribution is given to the partial solution of one of the set problems for the study of hard solar x radiation to the ionization of the D region. The threshold value of the flux leading to a noticeable change of ionization, as well as the relative increase of ionization expressed through absorption at a higher value of the flux leading to a noticeable change of ionization, as well as the relative increase of ionization expressed through absorption at a higher value of flux were found by directly comparing the supplementary flux of x radiation and the reaction caused by it in the D region. (JFP)

30929 QUASIVERTICAL SOUNDING OF IONOSPHERE AT TWO FREQUENCIES CLOSE TO f_0 F2. Nestorov, G. T.; Cohen, M. M. (Inst. of Geophysical, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 12, 1613-1616(1975).

Neglecting the absorption magnitude, the duration of reflection of signals having a frequency of 6.035 and 7.670 MHz were examined at the quasivertical incidence of the wave on the ionosphere. The data are shown and discussed. (JFP)

30930 ATMOSPHERIC WAVE INDUCED INSTABILITY IN THE E REGION. Beer, T. London, Ont.; Univ. of Western Ontario (1971). 157p. INIS.

Thesis.

It is shown that ionospheric E-region gradient instabilities induced by westward propagating internal atmospheric gravity waves in the presence of westward directed electric fields would explain the observed velocities and heights of nighttime sporadic E. The relationship between the thickness and horizontal extent of the low blanketing frequency sporadic E formed by this mechanism is plotted for various heights in the E-region. It is also pointed out that the drift motion of the ionization due to the perpendicular electric and magnetic fields can inhibit the formation of wind-shear sporadic E layers. The first quantitative assessment of the spatial resonance mechanism predicted by Whitehead (1971) is made, and it is shown that it is very unlikely to play any significant ionospheric role. In the course of this analysis, a number of D region results come to light and it is shown that in the D region all irregularities will tend to move with the ion drift velocity. (auth)

30931 PLASMA LINE MEASUREMENTS BY INCOHERENT SCATTERING AT NANCY AND FIRST MORPHOLOGICAL RESULTS. Vidal-Madjar, D. (Centre National d'Etudes des Telecommunications (CNET), 92 - Issy-les-Moulineaux (France). Dept. Recherches Spatiales Radioelectriques); Kofman, W.; Lejeune, G. (Grenoble-1 Univ., 38 (France). Centre d'Etudes des Phenomenes Aleatoires). Ann. Geophys.; 31: No. 2, 227-234(Apr 1975). (In French).

The first results from measurements of the incoherent scattering plasma line spectrum made using the St Santin-Nancay bistatic sounding system are presented. After a brief theoretical review it is shown how the measurement techniques make it possible to determine the following parameters accurately every 35 seconds, for a given altitude: the line frequency which measures the electron density; the line width which measures the electron density gradient in most cases; the line power which is a function of the photoelectron flux. Knowing these three parameters together makes it possible to measure the rapid fluctuations in electron density and to calculate the shape of the photoelectron spectrum for energies below 5eV. (FR)

30932 IONOSPHERIC EFFECTS DUE TO INTERPLANETARY NEUTRAL HELIUM. Fahr, H. J.; Blum, P. W. (Bonn Univ. (F. R. Germany). Inst. fuer Astrophysik und Extraterrestrische Forschung). Ann. Geophys.; 31: No. 2, 271-278(Apr 1975).

Interstellar neutral helium streams into the heliosphere and is focused strongly by the solar gravitation in the anti-apex direction of the streaming motion relative to the sun. Due to this effect relatively high interplanetary helium concentrations are predicted for a distance of about 1 AU from the sun near the ecliptic plane. The earth moves through this helium bulge in winter. The velocity of the helium flux is added to the orbital velocity of the earth. The particle stream is estimated to be above 10^7 particles/cm^2/sec during winter and 10^6 during summer. As the helium is neutral, it passes through the magnetosphere undisturbed. The energy of each atom is sufficient to ionize several neutral atoms of terrestrial atmosphere, but due to elastic collisions which compete very effectively with ionizing collisions only about 0.23 ionizations per incoming helium atom actually occur. This ionization source must be taken into account for the winter ionization balance, especially at night in the height region above 200 km. For the He^+ ion balance this source is of importance even during daylight hours over the whole year. (FR)

30933 STUDY OF ELECTRON PRODUCTION AND LOSS RATES IN THE EQUATORIAL ANOMALOUS IONOSPHERE USING THE GEOSTATIONARY SATELLITE SIGNALS. Kaushika, N. D. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)); Sen Gupta, A.; Setty, C. S. G. K. (Delhi Univ. (India). Dept. of Physics and Astrophysics). Ann. Geophys.; 31: No., 235-238(Apr 1975).

The continuous records of electron content made at S. J. Campos in Brazil are analyzed to investigate the integrated production rate (Q_0) and loss coefficient (β) in the ionosphere at magnetic dip 20 deg S. The overall average values of Q_0 and β are 2.8×10^{14} m^2sec^{-1} and 1.1×10^{-4} sec^{-1} respectively. Both of them exhibit seasonal variations. Daily values of Q_0 show good correlation with 10.7 cm solar flux intensity. Present results differ markedly from those reported for midlatitudes with regard to the seasonal variations. (FR)

30934 SOME OBSERVATIONS ON THE SPORADIC E-REGION AT CALCUTTA. Ganguly, S. (Calcutta Univ. (India)). Ann. Geophys.; 31: No. 2, 253-260(Apr 1975).

Simultaneous observations of the radio waves reflected from the E-layer and the F layer have been made at Calcutta covering

a series of frequencies. The apparent reflection coefficient of the E(s) layer and its dependence on frequency have been studied for various occasions. The temporal development of the E(s) and F echoes and their independences are investigated. Attempts have also been made to estimate the time variation of the peak of ionization during the growth and decay phases of the E(s) layer. A somewhat larger wind gradient and also apecies having a lower limit of α of about 10^{-8} cm^3sec^{-1} are necessary to explain the time variations of the estimated ionization values. (FR)

30935 SPREAD-F AT KODAIKANAL. Sastri, J. H.; Murthy, B. S. (Indian Inst. of Astrophysics, Kodaikanal). Ann. Geophys.; 31: No. 2, 285-296(Apr 1975).

Quarter-hourly ionograms of Kodaikanal for the period January 1968 to December 1969 have been examined for occurrence of Spread-F. Spread-F occurrence as a feature on ionograms is more or less a regular nocturnal event with little seasonal variation. There is a significant positive correlation between Spread-F occurrence and mean value of the H-component of the magnetic field. The effect of SC type magnetic storms is in general to inhibit the Spread-F incidence either on the same night or the succeeding night for both the pre- and post-midnight Spread-F. Several instances have been noticed when there is disappearance and subsequent appearance of Spread-F during a night within a span of a couple of hours or even less. Preliminary indication is that this feature is not dependent on the height of the layer crossing the threshold value for the production of irregularities and hence Spread-F. (FR)

30936 BASIC CHARACTERISTICS OF THE WHISTLING ATMOSPHERICS OBSERVED IN SOFIA. Ralcovski, C. Izv. Geofiz. Inst., Bulg. Akad. Nauki; 19: 141-147(1974). (In Bulgarian).

The basic parameters of the phenomenon "whistling atmospherics" which are recorded in Sofia after July 1970, are considered. The station with a geographical dipole latitude I = 42.7° is neither a typical middle latitudinal one nore a low latitudinal one. "Ordinary" whistlers as well as whistlers with extremely low dispersions, 15 $S^{\frac{1}{2}}$, are recorded in it. The processed material from the observations for the period August 1970–August 1971 permits the investigation of the diurnal and seasonal variations of the whistler's activity, the causes for them and the time of maximum whistler occurrence. The whistlers analyzed are short, one-hop type. The results show a maximum of whistler activity during the night hours of the local winter and an absolute minimum (lack of whistlers) around noon and during the whole day of August. From the dispersion investigation of the whistling atmospherics it is established that during the whole year and the whole day the dispersions remain approximately within the interval 40–70 $S^{\frac{1}{2}}$. This interval may be considered as typical for the station. When long two-hop type whistlers occur their dispersion does not surpass 105 $S^{\frac{1}{2}}$. No. information can be given about the nose and echo whistlers as they were not observed during the period under observation. (auth)

30937 POSSIBILITIES FOR THE USE OF THE fmin PARAMETER IN AERONOMIC STUDIES. Serafimov, K. Izv. Geofiz. Inst., Bulg. Akad. Nauki; 19: 85-96(1974). (In Bulgarian).

The effect of the various parameters of the stations for ionospheric vertical sounding on the minimal frequency of reflection fmin is analyzed. It is demonstrated that the variable coefficient of strengthening of the aerial and the variable power of the transmitter can be recorded by the selectivity of the station. The strong effect of radiodisturbances on the fmin after sunset and before sunrise is shown. The possible influence of the structural changes in the ionosphere on fmin, mainly in the case of high solar activity, is analyzed. A cosinusoid dependence on the zenith angle of the sun of the daily variations of fmin at high solar activity and in certain cases also at medium and low solar activity has been established. The seasonal dependence of fmin at a constant zenith angle of the sun is characterized by considerable winter and a weaker summer maximum which confirms the winter "anomaly" and the possibility to make use of the fmin in aeronomic investigations. (Abstr. Bulg. Sci. Lit.)

30938 INVESTIGATIONS OF THE IONOSPHERE CARRIED OUT WITH THE INTERCOSMOS-2. Gringaus, K.; Serafimov, K.; Schmelovsky, K.; Schmilauer, J. Izv. Geofiz. Inst., Bulg. Akad. Nauki; 19: 63-70(1974). (In Bulgarian).

The basic data are presented from the investigations with the "Intercosmos-2" satellite. The choice of a non-oriented site with chemical sources of current is well founded. The basic information is given concerning the experiments on board (made with ion traps, high frequency probes, Langmuir probes, a transmitter at coherent frequencies). A short summary is given of the results obtained during the two month investigations with these devices (peculiarities of the equatorial anomaly in the electron concentration distribution, diurnal variations of the electron temperature between 1200 and 3500°K, electron temperature vertical distribution, etc.). (auth)

30939 SEMI-AUTOMATIC READING OF DATA FROM IONOGRAMS WHEN CALCULATING N(h) PROFILES. Kutiev, I. Izv. Geofiz. Inst., Bulg. Akad. Nauki; 19: 97-103(1974). (In Bulgarian).

An algorithm and a program of a semi-automatic introduction of data from the ionograms when computing the electron concentration distribution in the ionosphere, are suggested. From a few points characteristic of the curves of the reflected signals, the whole necessary information is reestablished by means of interpolation. After that the information is introduced into the basic program computing the N(h) distribution. The realization of this program gives a possibility to reduce the time for preliminary processing of data. (Abstr. Bulg. Sci. Lit.)

30940 DEPENDENCE BETWEEN THE SPORADIC E LAYER AND IONOSPHERIC WIND. Spasov, H. V. C. R. Acad. Bulg. Sci.; No. 6, 783-786(1974). (In Bulgarian).

The question of formation of ionospheric differences for moderate geographic latitudes for an altitude of about 100 km under the action of abrupt changes in the direction and magnitude of the horizontal wind, is considered. It has been established that exceeding some critical speed of about 100 m/sec and shifting its direction to 180°, the horizontal wind leads to the formation of an additional ionized stratum which, together with the principal ionizing agents at this altitude, increases the general concentration of the E layer. (Abstr. Bulg. Sci. Lit.)

30941 DAILY VARIATIONS OF MAGNETIC-ION TWICE-REFRACTED COMPONENTS IN E LAYER. Pasova, C.; Serafimov, K. B. C. R. Acad. Bulg. Sci.; No. 6, 787-790(1974).

On the basis of the interpretation of the ionograms of the Sofia Ionospheric Station for the 1960-1973 period the regularities in the cases of appearance of magnetic-ionic split in the E-layer in daytime, are considered. The cases of existence of a sporadic E-layer were eliminated. A propagation with two maxima was established in the daily variations in the cases of appearance of the two magnetic-ionic components ("O" and "X" components) in the E-layer in day-time. A physical explanation is given of the appearance of disappearance of the "X" component, giving the minimal reflection frequency fmin as a suitable indicator of the general variations of the absorption L_0. Two factors determining the morning minimum in the appearance of the "X" component are indicated, namely: the closeness of the critical frequencies of the post-sunrise E-layer to the fmin and the closeness of the critical frequencies of the E-layer in the pre-sunset and the post-sunrise period to the frequency region which is strongly disturbed by radio transmitters. (Abstr. Bulg. Sci. Lit.)

30942 MODEL FOR PROPAGATION OF DUPLICATE WHISTLERS AT GEOMAGNETIC LATITUDES EXCEEDING 30°. Ralcovski, T. M. C. R. Acad. Bulg. Sci.; No. 3, 345-347(1974).

The characteristics of the duplicate whistlers observed in Sofia over a period of three years, are examined. The dispersion analysis in the 4-8 kHz. frequency range determines the division of the whistlers into two groups: whistlers with approximately identical dispersion of the two traces, and traces with a difference of the dispersion of 5-6 seconds. The results obtained from the delays, dispersions and the distance from the source make possible the making of a model of the propagation of this kind of whistlers. A conclusion has been drawn about the simultaneous excitation of the two ends of the magnetospheric duct. The difference in the conditions of propagation leads to two traces in the spectrographic recording. The different possibilities for the propagation of electromagnetic waves in the formation of duplicate whistlers are shown with the aid of the theoretical model. (Abstr. Bulg. Sci. Lit.)

30943 SEASONAL AND CYCLICAL VARIATIONS OF DEPENDENCE OF OPTIMUM ON MAXIMUM USABLE FREQUENCIES. Serafimov, K. B.; Lilov, A. L. C. R. Acad. Bulg. Sci.; No. 4, 479-482(1974).

On the basis of ionospheric observations in Sofia (1961-1972) and in Dourbes (1957-1972) an analysis is made of the seasonal and cyclical variations of the parameter Q which reflects the relative dispersion of the critical frequency of the F2(f_0 F2) layer. It has been established that: Ξ is not constant; the Ξ values deviate from 0.15 with a maximum of 0.4623 and a minimum of 0.040; Ξ follows a fixed seasonal curve with a spring maximum and a summer minimum; Ξ is strongly dependent on solar activity expressed in the relative number of sun spots R. The dependence $\Xi = \Xi(R)$ has been obtained for the different seasons. A physical interpretation is given of the seasonal dependence of the dispersion of the critical frequency f_0 F2. The seasonal and cyclical variations obtained actually increase the difference between the

optimum usable frequency (OUF) and the maximum usable frequency (MUF) at high solar activity and around equinoxes, while at a low solar activity this difference decreases. All this allows the planning and realizing of radiocommunications in the different seasons in a more stable and more rational manner. (Abstr. Bulg. Sci. Lit.)

30944 Pc5 PULSATIONS WITH PERIOD 300 TO 600 SEC. Gupta, J. C. (Dept. of Energy, Mines, and Resources, Ottawa). pp 363-373 of International Symposium on Solar-Terrestrial Physics. Volume 2. Sao Jose dos Campos, Brazil; Instituto de Pesquisas Espaciais (1974).

From proceedings of international symposium on solar-terrestrial physics; Sao Paulo, Brazil (17 Jun 1974).

A study of the characteristics of Pc_5 pulsations using the 1967 data from Canadian stations located in the subauroral, auroral and polar zones reveals that these pulsations occur most frequently in the auroral and polar zones with one morning and one evening peak; in the cusp-region occurrences maximize near local noon. Periods are shorter and amplitudes larger in the morning compared to evening hours. Periods increase with geomagnetic latitude from 60–70 deg. Amplitudes are almost always maximum near the central line of the auroral zone and decrease much more sharply towards lower than towards the higher latitudes. The occurrence-latitude and amplitude-latitude profiles show considerable diurnal variation and also variations with magnetic activity. In all three regions the occurrence and amplitude increase with magnetic activity to a certain level after which results become uncertain. Periods either do not change very much or at some stations decrease as activity increases. (IAA)

30945 OBSERVATION OF SEASONAL EFFECTS IN TRAVELING IONOSPHERIC DISTURBANCES BY THE DIRECTIONAL DEVIATION TECHNIQUE. Walton, E. K.; Bailey, A. D. (Univ. of Illinois, Urbana). Radio Sci.; 11: No. 3, 175-178 (Mar 1976).

An experiment was performed during the years 1962 through 1964 in which direction of arrival data were collected on pulse signals received over a 450 km east-west path. In order to determine the effect that traveling ionospheric disturbances (TIDs) had on these data, a "corrugation" model was proposed. The corrugation model assumes that TIDs can be treated as if they were moving cylindrical sinusoidal perturbations on the ionospheric reflecting surface. Lateral deviations in the experimental data of the type predicted by this model were found to be quite common. Variations in the detected TIDs as a function of time of year were found to be consistent with the "seasonal effect" studied by Munro in 1958, Jones 1969, and Davies and Jones in 1971. (auth)

30946 GLOBAL FEATURES OF LOWER IONOSPHERIC RADIO WAVE ABSORPTION IN RELATION TO MIDDLE ATMOSPHERIC TEMPERATURE VARIATION AND WIND CIRCULATION. Samanta, S. (Surendranath Coll., Calcutta). Radio Sci.; 11: No. 3, 179-188 (Mar 1976).

The A_1 absorption data for a large number of stations have been utilized to study the global features of the lower ionospheric radio wave absorption. The seasonal index n/sub s/ (defined in the relation L equals B/sub s/ (cos chi)/sup n//sub s/, where L is the monthly median value of absorption, and chi, the midmonth solar zenith angle), is found to decrease rapidly and smoothly with increasing latitude and also with increasing solar activity for all stations. The constant cos chi plot of seasonal values of absorption versus month shows summer as well as winter enhancements when considered on a global scale. Such plots versus latitude show maximum absorption values at around the tropical region, an increase in the absorption values at high latitudes above 50^0N, with a minimum around 40 to 50^0N, and a fall toward the equator below 23^0N during sunspot minimum. A secondary maximum with a strong peak is observed around 50^0N with a minimum around 45^0N during sunspot maximum. The plots of absorption values as well as temperatures for 30 and 50 km heights versus cos chi show loop-like structuring, indicating a considerable time dependence between them. Absorption and temperature at 30 km show a similar seasonal trend, whereas temperatures at 30 and 50 km show an opposite trend in their seasonal variations. The direction of looping of both temperature and absorption changes near about 35^0N between low and high latitudes. Both temperature and absorption show large variabilities during winter priods. These findings have been explained in terms of the seasonal variation of the middle atmospheric wind circulation, and the importance of the dynamics of the lower ionosphere in controlling the aeronomy has been demonstrated. (auth)

30947 LOWER IONOSPHERE EFFECTS ON THE PROPAGATION OF WAVES FROM AN elf/vlf SOURCE IN THE MAGNETOSPHERE. DeWitt, R. N.; Kelly, F. J.; Chayt, G. A. (Naval Research Lab., Washington, DC). Radio Sci.; 11: No. 3, 189-197 (Mar 1976).

A modified form of the Smith-Pitteway full-wave program is used in conjunction with various lower ionospheric profiles to calculate the propagation characteristics of ELF/VLF waves from a source in the magnetosphere, through the ionosphere. Expressions are developed which give the ratio of the power transmitted into the earth's surface to the power incident on the top of the ionosphere, as a function of the number of wave-hops in the earth-ionosphere waveguide. This depends upon the wave polarization after each hop and a limiting polarization is found after several hops. Numerical evaluation of these expressions is presented and discussed. (auth)

30948 COMPARISON OF THEORIES FOR INTENSITY FLUCTUATIONS IN STRONG TURBULENCE. Fante, R. L. (Cambridge Research Labs., Hanscom AFB, MA). Radio Sci.; 11: No. 3, 215-219 (Mar 1976).

Approximate solutions to Tatarskii's equation for the intensity scintillations of a wave propagating through a thin, highly turbulent layer have recently been developed by both the optical and radio astronomy communities. It is demonstrated here that these results, which are at first glance dissimilar, are in fact identical. (auth)

30949 CORRECTION OF NUMERICAL RESULTS IN "ELF TERRESTRIAL RADIO WAVE FIELD CALCULATIONS WITH THE ZONAL-HARMONICS SERIES". Lewis, R. L. (Univ. of Colorado, Boulder); Johler, J. R. Radio Sci.; 11: No. 2, 75-81 (Feb 1976).

The presence of a numerical error in a previous publication is noted and the error source identified. However, the theoretical formulation is correct. Corrected numerical results are presented which favorably compare with results computed by other researchers. Also, theoretical results are produced using a predicted ionospheric profile of an upper atmosphere nuclear detonation. Finally, field attenuation for hypothetical two-layer ionospheric profiles is plotted as a function of lower-layer conductivity. It is seen that some hypothetical cases can exhibit high attenuation values in comparison to the normal-day's attenuation value. Some new theoretical expressions for the zonal-harmonics analytical formulation are exhibited, and the improvement expected in computational efficiency and in numerical precision by breakoff of the ground wave from the rest of the summation is discussed. (auth)

30950 WAVELIKE PERTURBATIONS IN THE F REGION. Toman, K. (Cambridge Research Labs., Hanscom AFB, MA). Radio Sci.; 11: No. 2, 107-119 (Feb 1976).

Characteristics of wavelike perturbations in the F region are deduced from Doppler measurements made on CW transmissions between time station CHU, Ottawa, Canada, and AFCRL, Bedford, Massachusetts. For periods ranging from 5 to 100 min, occurrence frequencies and phase-path amplitudes of F-region perturbations are obtained for the years 1968 to 1970. While shorter periods are observed to occur more frequently than longer periods, peaks in the distribution are sometimes observed between 10 and 20 min. Amplitude distributions derived from phase-path undulations, which usually reveal an increase of amplitude with period, are at times found to fluctuate, indicating preferred bands of quasiperiodic activity in the F region. For selected ionospheric undulation events, ratios of phase-path amplitude to wavelength are estimated to be usually less than 0.02, but sometimes 0.05. The spectra of time series, derived from ionospheric Doppler measurements, are obtained by means of Fourier-analysis and maximum-entropy methods. These spectra are isometrically displayed using overlapping data windows while advancing in the time domain to observe the dynamics of ionospheric waves. Comparisons are made with comparable data samples derived from random numbers. While both spectral analyses show similar results, the maximum-entropy method appears to make it more certain that temporal changes of the spectra result from actual changes in the periods of wavelike ionospheric perturbations. For estimating the propagation effects resulting from the overhead passage of several traveling waves, mirrorlike reflection surfaces are synthesized computationally through the superposition of cylindrical waves of different characteristics. For a bistatic radar configuration, their effects on changing ray-azimuth deviations and Doppler shifts are illustrated. (auth)

30951 WAVE PROPAGATION IN A ONE-DIMENSIONAL RANDOM INHOMOGENEOUS MEDIUM. Ryzhov, Yu. A. (Radiophysical Research Inst., Gorky, USSR). Radio Sci.; 11: No. 2, 121-126 (Feb 1976).

The problem of wave propagation in a medium with random one-dimensional inhomogeneities of dielectric permittivity is considered in the approximation of a Markov random diffusion process. The solution of the diffusion equation for the distribution function of the reflection coefficient from the inhomogeneous slab is obtained. Some statistical moments of the solution are investigated. It is shown that the reflection coefficient has equally probable dis-

tribution of phase if the regular reflection at the boundaries of the layer vanishes. For this reason there is no regular component in a random reflected wave. Expressions are obtained for the intensity of the transmitted and reflected waves. A sufficiently thick layer reflects the whole energy of an incident wave in the form of the random scattered field energy. Also found are the formulas for the mean field inside the layer and behind it and for the effective permittivity of a one-dimensional random inhomogeneous medium. The problem is considered for two limiting cases of a small-scale (kl much less than 1) and a large-scale (kl much greater than 1) inhomogeneous medium. (auth)

30952 ELECTROMAGNETIC WAVES IN IRREGULAR MULTILAYERED SPHEROIDAL STRUCTURES OF FINITE CONDUCTIVITY: FULL WAVE SOLUTIONS. Bahar, E. (Univ. of Nebraska, Lincoln). Radio Sci.; 11: No. 2, 137-147(Feb 1976).

The propagation of electromagnetic waves excited by electric dipoles oriented along the axis of multilayered spheroidal structures of finite conductivity is investigated. The electromagnetic parameters and the thickness of the layers of the structure are assumed to be functions of the latitude. In the analysis, electric and magnetic field transforms that constitute a discrete and a continuous spectrum of spherical waves are used to provide a suitable basis for the expansion of the electromagnetic fields at any point in the irregular spheroidal structure. For spheroidal structures with good conducting cores, the terms in the solutions associated with the continuous part of the wave spectrum vanish. In general, however, when the skin depth for the core is large compared to its dimensions or when the sources are located in the core of the structure and propagation in the core is of special interest, the contribution from the continuous part of the wave spectrum cannot be neglected. At each interface between the layers of the irregular spheroidal structure, exact boundary conditions are imposed. Since the terms of the field expansions in the irregular structure do not individually satisfy the boundary conditions, Maxwell's equations are reduced to sets of coupled ordinary first-order differential equations for the wave amplitudes. The solutions are shown to satisfy the reciprocity relationships in electromagnetic theory. The analysis may be applied to problems of radio wave propagation in a nonuniform model of the earth-ionosphere waveguide, particularly when focusing effects at the antipodes are important. (auth)

30953 RELATIVISTIC ELECTRON PRECIPITATION IN THE AURORAL ZONE. Simons, D. J. College Park, MD; Univ. of Maryland (1975). 199p. University Microfilms Order No. 75-29,132.

Thesis (Ph. D.).

The energy spectra and pitch angle distributions of electrons in the energy range 50 keV to 2 MeV have been determined by a solid state electron energy spectrometer during the Relativistic Electron Precipitation (REP) event of 31 May 1972. The experiment was carried aboard a Nike-Cajun sounding rocket as the University of Maryland component of a joint American-Norwegian (NASA-NDRE) ionospheric investigation. The difficulty of determining the expected electron flux prior to the experiment required an instrument with a large dynamic range. The design and theoretical modeling of this instrument is described in great detail. The electron pitch angle distributions are determined from a knowledge of the rocket aspect and the direction in space of the Earth's magnetic field. The electron fluxes during the REP event were highly variable demonstrating correlated energy, flux and pitch angle pulsations with time periods less than one second. Increases in flux were accompanied by marked filling of the loss cone at lower energies (near 50 keV). Drawing upon the quasilinear equations of plasma wave-electron interactions, a theoretical model for the production of relativistic electrons is proposed. A self consistent set of fully relativistic equations for the evolution of the electron distribution function due to the interaction of the electrons with parallel propagating whistler waves is derived in the Appendix. An examination of these equations leads to the conclusion that at comparatively low background electron densities, the anomalous Doppler resonance leads to the acceleration of near relativistic particles. The results of a computer solution of the five coupled integrodifferential quasilinear equations confirms this conclusion. (Diss. Abstr. Int., B)

30954 CRITERION OF GEOMAGNETIC FIELD AT THE TIME OF DISAPPEARANCE OF EQUATORIAL E_{s-q} LAYER. Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). Indian J. Radio Space Phys.; 4: No. 1, 1-5(Mar 1975).

The condition of equatorial electrojet currents (or the electrostatic field) as derived from geomagnetic H field variation at the time of sudden disappearance of the equatorial sporadic E layer is discussed. This association between the reversed electrojet and disappearance of Es is confined to the q type of Es. The estimate of electron drift velocity to be between 100 and 250 m/sec at the time of disappearance of Es-q by some workers seems to be in error due to the inaccuracies in defining the base level for ΔH. The disappearance of Es-q occurs precisely when the latitudinal profile of ΔH is reversed and not necessarily when ΔH at an equatorial station decreases below the nighttime level. The present criterion is not affected by the choice of the time at which the H field is taken as the base level. (auth)

30955 VERTICAL DRIFT CALCULATIONS FROM UPWARD MOVING IONOSPHERIC IRREGULARITIES (KINKS) OVER THE MAGNETIC EQUATOR. Iyer, K. N.; Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). Indian J. Radio Space Phys.; 4: No. 1, 6-9(Mar 1975).

The occurrence pattern of ionospheric irregularities observed as sharp discontinuities (kinks), and vertical velocity in the equatorial F region, derived from their upward movement, have been compared for Kodaikanal, Natal and Huancayo. Longitudinal differences in the time of peak occurrence of these kinks and the distribution of vertical velocity are pointed out. The observed vertical velocities are in the range 10-40 m/sec, thereby excluding the possibility of Alfven waves or magneto-acoustic waves being responsible for the movement of these kinks. It is concluded that the observed vertical drifts represent the $E \times B$ drift in the equatorial F region and that the source of these kinks is metallic ions produced by equatorward neutral winds or gravity waves. (auth)

30956 OCCURRENCE OF M AND N ECHOES AT THE EQUATORIAL STATION, KODAIKANAL. Hanumath Sastri, J.; Suryanarayana Murthy, B. (Indian Inst. of Astrophysics, Kodaikanal). Indian J. Radio Space Phys.; 4: No. 1, 10-14(Mar 1975).

In quarter-hourly ionograms of Kodaikanal, close to the magnetic dip equator, for the period January-December 1968, M and N echoes occur in association with the Es configuration characteristic of the equatorial zone. Also one notices either an isolated M echo or a combination of M and N echoes but rarely an isolated N echo. The M and N echoes together occur mostly with blanketing Es and is basically a post-noon event wherens the M echo occurs usually with equatorial Es and is a pre-noon event with a characteristic seasonal variation. (auth)

30957 PHASE INTEGRAL CORRECTIONS TO RADIO WAVE ABSORPTION AND VIRTUAL HEIGHTS IN MODEL IONOSPHERIC LAYERS. Nath, N. (Univ. of Delhi). Indian J. Radio Space Phys.; 4: No. 1, 15-18(Mar 1975).

Approximate expressions for the phase integral corrections to absorption (A_{2x}) and virtual heights (h_{2x}) of radio waves reflected from model ionospheric layers for the extraordinary wave mode have been derived. The accuracy obtained using these formulae compares favorably with that obtained from similar formulae derived for the O-mode by J. E. Titheridge and M. R. Thorpe. The variations of the ratio of correction for the two modes (A_{2o}/A_{2x}) and ($h_2 0/h_{2x}$) as a function of the geomagnetic dip angle, the radio frequency and the electron density distribution have been studied. (auth)

30958 RESIDUAL DISTURBANCE FIELD (JD) IN THE INDIAN EQUATORIAL REGION. Bhargava, B. N. (Indian Inst. of Geomagnetism, Bombay). Indian J. Radio Space Phys.; 4: No. 1, 19-23(Mar 1975).

From 2nd general scientific assembly of IAGA on worldwide distribution of geomagnetic disturbances; Kyoto, Japan (Sep 1973).

The residual disturbance field has been derived at one low latitude station and three stations in the equatorial electrojet belt in the same longitude zone for typically quiet to moderately disturbed conditions by successive elimination of non-cyclic variation, S_q, L and D_{st}. The main features of the field, so computed from samples of data from high, relatively low and declining phases of solar activity cycle have been discussed. The component of the residual field at Trivandrum, close to the dip equator, which can be associated with the modulation of the electrojet by disturbance, has also been computed and found to consist primarily of a southward directed field around 10-11 hrs LT and, in two of the three samples, this is followed by a northward field in the afternoon hours. The relative magnitudes of these fields at the stations in the electrojet belt suggest an equatorial enhancement. A striking feature of the residual field, a progressive increase of its mean level with magnetic activity, is discussed in relation to return currents of the eastward and westward polar electrojets. (auth)

30959 ENERGY SPECTRUM OF ELECTRONS PRODUCED BY ELECTRON IMPACT IONIZATION OF HELIUM, NITROGEN AND OXYGEN MOLECULES. Jhanwar, B. L.; Khare, S. P.; Kumar, A. (Meerut Univ., India). Indian J. Radio Space Phys.; 4: No. 1, 33-39(Mar 1975).

An analytical expression based on Born-Bethe and Møller formulae is proposed for the energy spectrum of secondary electrons produced by the electron impact ionization of atoms and molecules. The results obtained for the ionization of He, N_2 and O_2 are in fair agreement with the experimental data of Opal et al. [Opal, C. B., Peterson, W. K. & Beaty, E. C., J. Chem. Phys., 55 (1971), 4100] for impact energy $E \geq 100$ eV and also with the Born calculations performed by employing generalized oscillator strength for $E \geq 300$ eV. (auth)

30960 EFFECT OF SUDDEN IONOSPHERIC DISTURBANCES ON THE FIELD STRENGTH OF AN lf RADIO SIGNAL IN RELATION TO SOLAR X-RAY FLUX IN DIFFERENT WAVELENGTH RANGES. Sen, A. K.; Saha, B. (Univ. of Calcutta). Indian J. Radio Space Phys.; 4: No. 1, 40-43(Mar 1975).

The SID effects observed on the field strength of an lf radio signal at 280 kHz transmitted from Jessore (lat., 23° 10′N; long., 89° 10′E) in Bangladesh at a distance of about 110 km from Calcutta (lat., 22° 34′N; long., 88° 24′E) often appears as an SES or an SAS and the effect sometimes appears to be superimposed on a long duration absorption of signal. From a correlation of the SID data obtained during the period June 1972-May 1973, with the solar X-ray flux in the different wavelength ranges, it appears that the relative strength of the 0·5-3 Å flux with respect to the 1-8 Å flux would be important in determining the form of the effect. An SID effect appears to occur as an SES when the ratio of 0·5-3 Å flux to 1-8 Å flux is greater than about 0·025, while it tends to appear as an SAS when the ratio is less than about 0·025. The long duration absorption of signal appears to be associated with the longer-life soft X-ray flux in the wavelength range of 8-20 Å. (auth)

30961 INFLUENCE OF MAGNETIC DECLINATION OF THE NOON BITE-OUT PHENOMENON OF THE EQUATORIAL F2 REGION. Sanyasi Raju, P. T. (Andhra Univ., Waltair, India); Mukunda Rao, M. Indian J. Radio Space Phys.; 4: No. 1, 44-45 (Mar 1975).

The effect of magnetic declination of the noon bite-out phenomenon is investigated. The occurrence of critical sunspot number for east declination stations during the sunspot minimum period and for west declination stations during sunspot maximum period is explained on the basis of the theoretical model of R. A. Goldberg. (auth)

30962 SUNRISE EFFECT ON THE FIELD STRENGTH OF AN lf RADIO SIGNAL IN RELATION TO THE COSMIC RAY LAYER OF THE IONOSPHERE. Sen, A. K.; Saha, B. (Univ. of Calcutta). Indian J. Radio Space Phys.; 4: No. 1, 65-68(Mar 1975).

The daily records of the field strength of an lf radio signal on 280 kHz (call sign CB) transmitted from China Bay (lat., 9° 11′N; long., 81° 11′E) in Ceylon at a distance of about 1800 km from Calcutta (lat., 22° 34′N; long., 88° 24′E) have been examined to explore the role of the cosmic ray layer during sunrise. The results of an analysis of the records obtained during the 1-yr period from June 1972 to May 1973, indicate that even in this low latitude the cosmic ray ionization plays an important role during sunrise and that the start of the sunrise is discernible when the ground grazing solar rays strike the 70 km level. The results also indicate that the duration of the sunrise fall of field strength is governed by the subsequent development of ionizations in the C-layer. (auth)

30963 SPORADIC-E FORMATION DUE TO NEUTRAL WINDS IN THE EQUATORIAL IONOSPHERE. Dahiya, R.; Verma, P.; Setty, C. S. G. K. (Univ. of Delhi). Indian J. Radio Space Phys.; 4: No. 1, 69-76(Mar 1975).

The ionization redistribution favoring the formation of thin Es layers due to neutral wind-shears has been investigated. The equations of motion for electrons and ions have been solved for the vertical velocity of ionization, taking into account the effect of the neutral wind velocity through the term containing the effective collision frequency. For simplicity, both electrons and ions have been assumed to be moving with the same velocity. The neutral wind velocity in the east-west direction has been assumed to be a sinusoidal function of the vertical height, where the wavelengths have been chosen empirically. Using the above velocity profiles for ionization, the continuity equation has been solved numerically using various input parameters such as the effective recombination coefficient, intensity of the electric field, and amplitude of the vertical velocity of ionization. It has, thus, been possible to generate theoretical models showing thin intense Es layers and models of vertical velocity profiles which can be compared favorably with those available from experimental results. (auth)

30964 ATMOSPHERIC FLUORESCENCE PULSES AT NAINITAL. Srivastava, R. K.; Srivastava, B. N. (DSB Government Coll., Nainital, India). Indian J. Radio Space Phys.; 4: No. 1, 83-85(Mar 1975).

Preliminary study of the characteristic pulsations of atmospheric fluorescence of 1800 microsecond time has been made and some important correlations also have been made. (auth)

30965 TIDs IN EQUATORIAL ANOMALY REGION. Kaushika, N. D. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). Indian J. Radio Space Phys.; 4: No. 1, 86-88(Mar 1975).

Medium scale TIDs in the equatorial anomaly region are investigated using the continuous records of electron content. TIDs are more intense during nightime and often commence around sunrise and sunset times. It is suggested that sunrise heating and sunset cooling of the atmosphere could be the possible source of gravity waves causing these disturbances. (auth)

30966 PROTON CURRENTS WITH $E_p > 70$ keV AT LOW ALTITUDES IN THE EQUATORIAL REGIONS. Butenko, V. D.; Grigoryan, O. R.; Kuznetsov, S. N.; Malkiel, G. S.; Stolpovskii, V. G. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 4, 457-460 (1975).

Translated from Kosm. Issled.; 13: No. 4, 508-512(1975).

Protons with $E_p > 70$ keV are studied at low altitudes in the equatorial region. Measurements were made with a proportional counter installed aboard the satellite Kosmos-484. At 17-5^h MLT protons with $E_p > 70$ keV were recorded at $L \leq 1.25$, while at 5-17^h MLT no proton currents were recorded within or outside the South Atlantic anomaly. Results are compared with other satellite measurements. Between the proton flow zones near the equator and at middle latitudes there exists a region where no protons with $E_p > 70$ keV are observed. The existence of a local proton-acceleration mechanism and the necessity of considering ionospheric electric fields are suggested. (auth)

30967 ROCKET STUDIES OF CORPUSCULAR RADIATION AT VARIOUS GEOMAGNETIC LATITUDES. Tulinov, V. F.; Feigin, V. M.; Zhuchenko, Yu. M.; Lipovetskii, V. A.; Novikov, L. S. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 4, 461-466 (1975).

Translated from Kosm. Issled.; 13: No. 4, 513-520(1975).

Results of an investigation of corpuscular radiation obtained from a series of MR-12 meteorocket firings are given. The experiment was conducted in the summer of 1973 at various geomagnetic latitudes in the Atlantic Ocean (XVII voyage of the scientific-research vessel Professor Vize) and in middle latitudes of the Soviet Union (Volgograd area). Previous studies concerned with the polar regions are used for analysis of latitude distribution of the corpuscular radiation. Rocket and satellite measurements of incident radiation are compared. (auth)

30968 ONE POSSIBILITY FOR DETERMINING THE COLLISION FREQUENCY AND TEMPERATURE OF ELECTRONS IN THE OUTER IONOSPHERE. Givishvili, G. V.; Fligel, M. D. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 4, 473-476(1975).

Translated from Kosm. Issled.; 13: No. 4, 528-531(1975).

Simple equations describing the absorption of radio waves in the outer ionosphere are obtained. The possibility of determining profiles of the frequency of collisions of electrons with ions and of the electron temperature above the maximum of the F2 layer from data on the absorption at several frequencies emitted from a satellite is examined. (auth)

30969 CONVECTIVE INSTABILITY OF THE POLAR IONOSPHERE. Abramov, L. A.; Al'perovich, L. S. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 4, 477-482(1975).

Translated from Kosm. Issled.; 13: No. 4, 532-538(1975).

Phenomena due to heating of the polar ionosphere in the region of the electrojet are considered. Besides stationary convection due to the temperature gradient, one can have an oscillatory instability associated with an anomalous gradient in the concentration of monotonic gases; this gradient arises when there is intensive precipitation of electrons. The amplitude and other parameters of the geomagnetic variations that can be a consequence of the development of a convective instability of the ionospheric gas are estimated. The results can explain the local character of some of the high-latitude geomagnetic disturbances. 15 references. (auth)

30970 SCATTERING OF ELECTROMAGNETIC WAVES IN THE TURBULENT WAKE OF SATELLITES IN THE ATMOSPHERE. Valuev, V. V. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 4, 483-487(1975).

Translated from Kosm. Issled.; 13: No. 4, 539-543(1975).

In the Born approximation, a calculation is made of the effective scattering cross section of the turbulent wake formed in the atmosphere behind a satellite moving supersonically. The theoretical calculations are compared with the experimental data. 15 references. (auth)

30971 EXPERIMENTAL APPARATUS FOR STUDIES OF THE FINE STRUCTURE OF LOW-FREQUENCY ELECTROMAGNETIC

PROCESSES AND SOME RESULTS OF ITS TESTS. I. Al'pert, Ya. L.; Bashilov, I. P.; Mikhailova, G. A.; Kapustina, O. V.; L'vova, G. P. Cosmic Res. (USSR)(Engl. Transl.); 13: No. 4, 488-496(1975).

Translated from Kosm. Issled.; 13: No. 4, 544-554(1975).

A brief description is given of an experimental apparatus intended for studies of the fine structure of the spectra of wave packets excited in the near-earth plasma and recorded near the earth's surface or on an artificial earth satellite. The frequency range of the apparatus is 40-15 kHz. A time resolution $\Delta t = 250 \cdot 10^{-6} - 16 \cdot 10^{-6}$ sec and a frequency resolution $\Delta F =$ 2-64 Hz are obtained in different parts of the spectrum of oscillatory processes studied. Some results of tests of the apparatus using theoretical specified oscillatory processes, sources of the laboratory type, and wave packets of natural origin are presented. (auth)

30972 EXPERIMENTAL INVESTIGATIONS OF NONLINEAR EFFECTS IN THE IONOSPHERIC F-REGION. Mityakov, N. A.; Rapoport, V. O.; Trakhtengerts, V. Yu. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 19: No. 1, 33-42(1976). (In Russian)

The results of experimental works on diagnostics of artificial ionospheric disturbances arising when the ionospheric F-region is affected by a powerful SW radiation. An artificial heating of F-region is accompanied by formation of different scale ($l = 1 + 10^7$ cm) inhomogeneities which influence essentially SW radio wave propagation. (auth)

30973 RADIO WAVE SCATTERING IN IONOSPHERIC WAVE CHANNELS. Gurevich, A. V.; Tsedilina, E. E. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 19: No. 1, 43-58(1976). (In Russian)

The influence of scattering on radio wave propagation in ionospheric wave channels is investigated. The diffusion equation is derived which describes a change due to scattering of the field intensity distribution over adiabatic invariants (i.e. over channel wave modes). By the example of a parabolic channel, the wave mode intensity distribution, trapping, absorption and escaping of radiation from channels are investigated. (auth)

30974 CONSTRUCTION OF SOLUTION OF ETALON EQUATION FOR THE PROBLEM OF PROPAGATION OF A PLANE VERTICAL-POLARIZATION WAVE IN AN INFINITE LAYER WITH MAXIMUM ELECTRON DENSITY AT SMALL LOSSES. Zernov, N. N.; Makarov, G. I. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 19: No. 1, 64-70(1976). (In Russian)

The problem of propagation of the electromagnetic vertical-polarization field is considered in a medium, the real part of the dielectric permittivity of which changes in space according to the parabolic law and the imaginary part is constant. The solution is constructed which describes the field in the whole space on the assumption of small losses and that the real part of the dielectric permittivity at the parabola apex is close to zero. (auth)

30975 TIME VARIATIONS OF SOME CHARACTERISTICS OF PULSES PROPAGATING IN AN INFINITE SCATTERING MEDIUM. Apresyan, L. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 19: No. 1, 82-90(1976). (In Russian)

Equations are derived from the radiative transfer equation for space moments of pulses propagating by fluctuations in a randomly homogeneous and stationary medium. The lowest spatial moments describe the volume-averaged pulse characteristics such as the energetic spectrum, gravity center radius-vector and mean-square pulse broadening. The equations for the moments are solved in the case of scattering of radiation by small-scale electron density fluctuations in a cold plasma. Some estimations are given for the pulse frequency spectrum in the case of scattering by large-scale fluctuations. (auth)

30976 ACCOUNT OF THE DEPENDENCE OF THE REFLECTION COEFFICIENT ON THE IONOSPHERE INCIDENCE ANGLE FOR CALCULATION OF VLF FIELDS AT SHORT DISTANCES. Orlov, A. B.; Pronin, A. E. (Leningrad State Univ.). Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 18: No. 12, 1786-1793(1975). (In Russian)

The problem of reflection from an inhomogeneous isotropic ionosphere of a VLF field radiated by a point source is considered. The accuracy of the solution obtained by the stationary phase method is investigated for the case when the observation point is located from the radiator at the distance less than 1000 km. Different forms of taking into account the dependence of the reflection coefficient on the incidence angle are discussed. The applicability of the formulas obtained is estimated by comparing with the result of numerical integration.

Effects of Nuclear Detonations

30977 IONOSPHERIC DISTURBANCES DETECTED OVER HAWAII AFTER THE 1968 FRENCH THERMONUCLEAR EXPLOSION. Najita, K.; Huang, Y. N.; Fang, G. T. N. (Hawaii Univ., Honolulu (USA)). Ann. Geophys.; 31: No. 2, 301-310(Apr 1975).

An analysis of the ionospheric disturbances detected in Hawaii by means of a Doppler H. F. sounding system, following the French thermonuclear explosion of 1968 in French Polynesia, shows 5 different types of waves: W_1, W_2, W_3, W_4 and W_5. Waves W_4 and W_5 have been identified as pseudo-modes L_0' and A_0' with 4 and 5-minute periods respectively. Although it was not possible to show conclusively that modes W_1, W_2 and W_3 (periods of over 14 minutes) satisfied the characteristics of dispersion curves for supermodes, studies by cross-correlation have shown that their source was situated south of the Hawaiian Islands and that the waves were propagating toward the north (northward) at an average speed (velocity) of 350 m/s. (FR)

Magnetospheric Phenomena

Refer also to abstracts 30506, 30509, 30517, 30708, 30922, 30924, 30942, and 30947.

30978 (COM-74-50276-35) CATALOGUE OF DIGITAL GEOMAGNETIC VARIATION DATA AT WORLD DATA CENTER A FOR SOLAR-TERRESTRIAL PHYSICS. (World Data Center A for Solar-Terrestrial Physics, Boulder, Colo. (USA)). Jul 1974. 28p. National Climatic Center, Asheville, NC $0.20.

All of the geomagnetic data available on magnetic tape in world data center A for solar-terrestrial physics is listed. Other information of interest is also provided. (GRA)

30979 REVIEW OF SELECTED SCIENTIFIC RESULTS OF HEOS 2. Page, D. E.; Wenzel, K. P. (European Space Research and Tech. Centre, Noordwijk, Netherlands). pp 433-454 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

The main scientific mission aims of the highly eccentric orbiting satellite HEOS 2 are the exploration of the polar magnetosphere in the previously unexplored region above the northern polar cap and the investigation of properties of the interplanetary space. This paper reviews results obtained from the seven scientific experiments during 1972 and early 1973 with emphasis on phenomena observed in the high-latitude magnetosphere and around its boundaries. Observations on position, plasma flow and plasma turbulence in the mid-altitude polar cusp are summarized. A stable well ordered magnetic field with only small fluctuations is encountered in the polar magnetosphere. The high-latitude magnetopause is encountered on the average about 20% further away from earth than theoretical models and measurements at lower latitudes would indicate. A new region of streaming protons – termed plasma mantle and covering a large part of the magnetosphere poleward of the polar cusp – is persistently seen by HEOS 2. Electrons of unexpectedly high energies (~1 MeV) are seen at the tail magnetopause indicating a more or less permanent layer along this boundary. Both phenomena may be related to field line reconnection on the dayside of the magnetosphere. Some results on solar particle propagation and on the interplanetary magnetic field are also reported. (auth)

30980 FEATURES OF THE INTENSITY VARIATIONS AND SPECTRUM OF LOW ENERGY PROTONS IN THE POLAR CUSP. Kovalskaya, I. Ya.; Panasyuk, M. I.; Ryumin, S. P.; Sosnovets, E. N.; Stolboushkin, S. K.; Tverskaya, L. V.; Khorosheva, O. V. (Moscow State Univ.). pp 455-459 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Measurements made aboard the Molniya 1 satellite in February–March 1973 are used to study variations of the proton intensity in the 65–235 keV and 235–370 keV energy ranges in the high-latitude regions of the day-side magnetosphere. A region of increased proton intensity with a peak at latitudes of 76–78° can be observed, under conditions of moderate magnetic disturbance, beyond the trapped radiation zone boundary determined on the basis of >40 keV electron data. Strong displacements of the cusp towards low latitudes (down to 68°) were repeatedly observed. The displacements were accompanied by a decrease in the cusp width (down to ≃1°). Such considerable displacements of the cusp occurred during ring current enhancement and were connected with the development of powerful auroral electrojets and their penetration to lower latitudes. Simultaneous measurements of protons of the same energies in interplanetary space (aboard the Prognoz satellite) have shown that their fluxes are at least one order of magnitude smaller than those in the cusp. This result could be indicative of the magnetospheric origin of the protons observed in the cusp. (auth)

30981 STRONG PITCH-ANGLE DIFFUSION OF PROTONS DURING THE MAGNETIC STORM OF 19 MARCH 1973. Kovtyukh, A. S.; Panasyuk, M. I.; Sosnovets, E. N. (Moscow State Univ.). pp 485-489 of Space Research XV. Rycroft, M. J. (ed.). Berlin; Akademie-Verlag (1975).

From 17th Plenary meeting of COSPAR; Sao Paulo, Brazil (Jun 1974). See CONF-7406116.

Molniya 1 measurements during the magnetic storm on 19 March 1973 are used to examine variations in the pitch-angle distribution of low-energy protons (100-650 keV) in the outer regions of the radiation belt ($4 < L < 6$). The observed variations have been shown to be related to the displacement of the region of strong pitch-angle diffusion of protons deep into the radiation belt during the main phase of the storm studied. (auth)

30982 EXPLAINING THE OCTOBER EFFECT IN THE MESOSPHERE OF MEDIUM LATITUDES. Velinov, P. I. (Geophysical Inst., Sofia). C. R. Acad. Bulg. Sci.; 28: No. 10, 1367-1369(1975).

An attempt is made to furnish additional explanations of the October effect considering tidal-gravitational wave, wind circulation, and air current effects. (JFP)

30983 ON THE TRIGGERING OF AN ISOLATED MAGNETIC SUBSTORM: A THEORY. Sinha, M.; Sundaram, A.K. (Physical Research Laboratory, Ahmedabad 380 009, India). Geophys. Res. Lett: 3: No. 2, 57-60 (Feb 1976).

We propose a high frequency electromagnetic instability of non resonant type, driven by cross current as a source for the onset of substorm expansion phase and the field line reconnection beyond 15 R_E. By including a normal component of the tail field, B_Z, we find that the instability can be quenched provided B_Z exceeds certain threshold value $\sim 1.8 \times 10^6 \sqrt{Te/\lambda}$ gauss (0.06γ, for typical values in the neutral sheet). (auth)

30984 PERSISTENT PRESSURE ANISOTROPY IN THE SUBSONIC MAGNETOSHEATH REGION. Crooker, N.U.; Siscoe, G.L. (Department of Meteorology, University of California, Los Angeles, Ca. 90024); Geller, R.B. Geophys. Res. Lett. 3: No. 2, 65-68 (Feb 1976).

Observations of proton flux in the subsonic flow region of the magnetosheath show double peaks as a function of angle in the equatorial plane of the spacecraft. The peaks are separated by a wide angle, usually more than 90°. Suggestions of double flux peaks are present in 95 percent of the data. They are interpreted as the effect of a persistent pressure anisotropy. The clearest cases were analyzed to determine the orientation of the flux peaks relative to the magnetic field and direction of model hydrodynamic flow. They are shown to be consistent with a greater pressure perpendicular to the field. Possible sources of pressure anisotropy in the magnetosheath are discussed. (auth)

30985 MAGNETOSPHERIC SUBSTORMS AND AURORAL PARTICLE PRECIPITATION. Chacko, C. C. Chestnut Hill, MA; Boston Coll. (1975). 127p. University Microfilms Order No. 75-20,698.

Thesis (Ph. D.).

Low energy (1-13 keV) particle data gathered by the low altitude polar satellite ESRO 1 A is considered. Substorm-time is used as the ordering parameter for 538 satellite passes and the statistical results thus obtained are compared with those following from K/sub p/-ordering. Detailed examinations of several sets of consecutive passes are also presented. The major results of this work are the following. Average latitudinal profiles of 6-keV proton precipitations in most local time sectors for the K/sub p/-ranges 0_0-1_+, $2_- - 3_0$ and 3_+-5_0 as well as for prolonged-quiet, quiet, substorm and post-substorm periods are compiled. It is concluded that while K/sub p/ remains a useful parameter for ordering particle precipitation data, substorm-time ordering is to be preferred. During geomagnetic storms, a gap is found to develop in the latitudinal profiles of low energy electrons and protons precipitating in the early evening (approximately 1630 hrs) local time region. The characteristics of this gap are enumerated. An abrupt termination of all particle activity on the poleward side of the precipitation region, evidenced by steep latitudinal gradients affecting all energy channels, is observed to be a frequent feature on the night side during substorms. The main precipitation region on the night side occasionally develops a low intensity poleward tail during quiet periods. It is found that low altitude polar satellites can directly observe plasma injection into the inner magnetosphere during substorms. Direct injection at local times at least as early as 18 hrs has thus been observed. These findings indicate that direct plasma injection is not confined to the near-midnight sector but extends westward as far as dusk, during intense substorms. (Diss. Abstr. Int., B)

30986 RELATIONSHIP BETWEEN SOLAR MAGNETIC SECTOR STRUCTURE AND GEOMAGNETIC DST. Kane, R. P. (Physical Research Lab., Ahmedabad (India)). Proc. Indian Acad. Sci., Sect. A; 81: No. 6, 233-244(Jun 1975).

The occurrence of geomagnetic Dst, AE and Kp with respect to the passage of well-defined boundaries of the interplanetary magnetic field sector structure near the earth is studied. It is concluded that the sector structure is not related to the changes in Dst and possible reasons for the observed behavior are discussed.

30987 METASTABLE STATES OF DIFFUSE NEUTRAL SHEET AND THE SUBSTORM EXPLOSIVE PHASE. Galeev, A.A.; Zelenyi, L.M. (Institute of Space Research, USSR Academy of Sciences). JETP Lett. 22: No. 7, 170-172 (5 Oct 1975).

We consider the nonlinear theory of explosive instabilities of the diffuse neutral sheet produced as a result of resonant interaction with electrons or ions. It is shown that in sufficiently thin sheets there can occur metastable states relative to the buildup of ion instability. The results can be used to explain theoretically the explosive phase of magnetospheric substorms. (auth)

30988 MAGNETIC FIELDS OF THE MAGNETOSHEATH. Fairfield, D. H. (Goddard Space Flight Center, Greenbelt, MD). Rev. Geophys. Space Phys.; 14: No. 1, 117-134(Feb 1976).

The magnetic field of the magnetosheath is most naturally discussed in terms of its steady state and its fluctuating components. The theory of the steady state field is quite well developed, and its essential features have been confirmed by observations. The interplanetary field is convected through the bow shock where its magnitude is increased and its direction changed by the minimal amount necessary to preserve the normal component across the shock. Convection within the magnetosheath usually increases the magnitude still further near the subsolar point and further distorts the direction until the field is aligned approximately tangent to the magnetopause. Fluctuations of the magnetosheath field are very complex, variable, and not well understood. Power spectra of the field typically vary as $1/f$ or $1/f^2$ below and $1/f^3$ above the proton gyrofrequency. Spectral peaks are common features which occur at different frequencies at various times. Transverse waves are often dominant at frequencies less than or equal to 0.002 Hz, and compressional waves are often dominant at somewhat higher frequencies. Perturbation vectors of hydromagnetic waves tend to be aligned with the shock and magnetopause surfaces. Magnetosheath waves may be generated upstream, within the magnetosheath, at the bow shock, or at the magnetopause, but the relative importance of these sources is not known. 83 references. (auth)

30989 PERIODICITIES IN THE NIGHT FIELD STRENGTH AT 164 kHz. Leftus, V.; Nestorov, G. T. C. R. Acad. Bulg. Sci.; No. 4, 475-478(1974).

With the aid of a Fourier-transformation of the autocorrelation function a study was made of the temporary variations of the strength of the field at 174 kHz (transmitter Allouis, France, monitored Sofia, Bulgaria) over the period from October 1, 1959 to December 31, 1972. Periodicities of 333-400; 200-222; 125; 90.9, 71.4 and 55.5 days were observed. The existence of 125 and 62.5-day periods as an amplitude modulation of the seasonal course (333-400 days) and the 90.9 period in solar activity is discussed. The absence of the 27-day period is assumed to be the effect of compensation of positive and negative effects of ionospheric disturbances, observed at 164 kHz, as a result of geomagnetic disturbances caused by particle incidence. (Abstr. Bulg. Sci. Lit.)

30990 INHOMOGENEITY OF THE RADIATION BELTS ENERGETIC ELECTRONS FLUXES AT LOW ALTITUDES. Adiushin, S. I.; Burov, V. A.; Malyshev, A. B.; Kulaguin, Y. M. pp 384-395 of International Symposium on Solar-Terrestrial Physics. Volume 2. Sao Jose dos Campos, Brazil; Instituto de Pesquisas Espaciais (1974).

From proceedings of international symposium on solar-terrestrial physics; Sao Paulo, Brazil (17 Jun 1974).

A description of electron inhomogeneities in the zone of stable trapping within the earth's radiation belts is given. Measurements were made by a low orbiting satellite between January and April 1972. Electrons were detected by four Geiger counters at threshold energies of 0.15, 0.7, 1.7 and 3.3 MeV. Two types of inhomogeneities were recorded. The first involved localized sharp falls in electron intensity coinciding with the expansive phase of geomagnetic substorms, while the second involved an increase in particle flux in various areas along magnetic force lines. It is postulated that hot plasma clouds intrude into the geomagnetic trap during substorms, weakening the magnetic field and dispersing particles through the plasma-pinch effect. This would account for both inhomogeneities, since the dispersed electrons would travel along magnetic force lines and an increased particle flux in several areas would be observed along with localized drops in electron intensity. Thus, a possible connection between the two phenomena is noted. (IAA)

30991 SUBSTORM-ASSOCIATED LONG-PERIOD HYDROMAGNETIC WAVES. Wang, C. S.; Lee, T.; Kim, J. S. (State Univ. of New York, Albany). pp 374-383 of International Symposium on Solar-Terrestrial Physics. Volume 2. Sao Jose dos Campos, Brazil; Instituto de Pesquisas Espaciais (1974).

From proceedings of international symposium on solar-terrestrial physics; Sao Paulo, Brazil (17 Jun 1974).

The analysis of magnetograms recorded at stations extending from Northern to Southern Hemispheres in a longitudinal range of about 115 degrees has shown the existence of long-period hydromagnetic waves at middle- and low-latitude stations prior to and/or simultaneous with the polar substorm. It is found that these hydromagnetic waves have different polarization. For waves that appeared prior to the substorm, the direction of the polarization of the horizontal perturbation vector in the H-D plane is clockwise at stations in the Northern Hemisphere for an observer looking down along the magnetic field line and counterclockwise at stations in the Southern Hemisphere. For waves that occurred simultaneously with substorms, the direction of the polarization is counterclockwise in both hemispheres. The simultaneous appearance of these waves at all low- and middle-latitude stations in both hemispheres suggests that the oscillations of magnetic field lines in the plasmasphere are coupled. The implication to the substorm will be discussed. (IAA)

30992 GEOMAGNETIC EFFECT IN THE MEAN THERMOSPHERE. Vercheval, J. (Institut d'Aeronomie Spatiale de Belgique, Brussels). Ann. Geophys.; 31: No. 2, 261-270(Apr 1975). (In French).

The results of a density analysis for the altitude range between 165 and 215 km, are given and related to the geomagnetic aciivity effect: in particular, the existence of a daily density variation in the mean thermosphere could be associated with the "McIntosh component" of the activity. (FR)

30993 METHOD OF SIGNAL ANALYSIS. Berthomier, C. (Centre National d'Etudes des Telecommunications (CNET), 92 - Issy-les-Moulineaux (France)). Ann. Geophys.; 31: No. 2, 239-252(Apr 1975). (In French).

A method capable of handling the amplitude and the frequency time laws of a certain kind of geophysical signals is described here. This method is based upon the analytical signal idea of Gabor and Ville, which is constructed either in the time domain by adding an imaginary part to the real signal (in-quadrature signal), or in the frequency domain by suppressing negative frequency components. The instantaneous frequency of the initial signal is then defined as the time derivative of the phase of the analytical signal, and his amplitude, or envelope, as the modulus of this complex signal. The method is applied to three types of magnetospheric signals: chorus, whistlers and pearls. The results obtained by analog and numerical calculations are compared to results obtained by classical systems using filters, i.e., based upon a different definition of the concept of frequency. The precision with which the frequency-time laws are determined leads then to the examination of the principle of the method and to a definition of instantaneous power density spectrum attached to the signal, and to the first consequences of this definition. In this way, a two-dimensional representation of the signal is introduced which is less deformed by the analysis system properties than the usual representation, and which moreover has the advantage of being obtainable practically in real time. (FR)

30994 ELECTROSTATIC NOISE BANDS ASSOCIATED WITH THE ELECTRON GYROFREQUENCY AND PLASMA FREQUENCY IN THE OUTER MAGNETOSPHERE. Shaw, R. R. Iowa City, IA; Univ. of Iowa (1975). 115p. University Microfilms Order No. 76-2178.

Thesis (Ph. D.).

Naturally occurring noise bands near the electron plasma frequency are frequently detected by the University of Iowa plasma wave experiment on the IMP 6 satellite in the region from just inside the plasmapause to radial distances of about 10 earth radii in the outer magnetosphere. The electric field strength of these noise bands is usually small with electric field spectral densities near 10^{-15} volts^2 meter^{-2} Hz^{-1}. A wave magnetic field has been detected only in a few unusually intense cases, and in these cases the magnetic field energy density is several orders of magnitude smaller than the electric field energy density. The bands are observed at all magnetic latitudes covered by the IMP 6 orbit (parallel gamma/sub m/ parallel less than or equal to 45^0) and appear to be a permanent feature of the outer magnetosphere. They are found at all local times and occur least frequently in the quadrant from 18 to 24 hours. The bands appear to consist of two distinct spectral types, diffuse and narrow. In both types the center frequency of the noise band is bounded by consecutive harmonics of the electron gyrofrequency, and the bands occur most often between harmonics that are near the local electron plasma frequency. These bands appear to merge continuously into two types of plasma wave emissions that are found in dissimilar regions of the magnetosphere (upper hybrid resonance noise, also called Region 3 noise, inside the plasmasphere and (n + 1/2)f/sub g/ harmonics in the outer magnetosphere). It is suggested that this smooth merging is caused by changes in the plasma wave dispersion relation that occur as the spacecraft moves from the cold plasma within the plasmasphere into the warm non-Maxwellian plasma found in the outer magnetosphere. (Diss. Abstr. Int., B)

30995 SPREADING OF WAVES EMITTED FROM AN ELF/VLF SOURCE IN THE MAGNETOSPHERE. Kelly, F. J.; Baker, D. J.; Chayt, G. A. (Naval Research Lab., Washington, DC). Radio Sci.; 11: No. 2, 93-106(Feb 1976).

Electromagnetic waves from an ELF/VLF source in the magnetosphere may be propagated through the ionosphere to receiving antennas on the earth's surface. Among many factors important in estimating the received signal strength is the geometric spreading factor, d OMEGA/dA/sub E/, measuring the area, dA/sub E/, of the earth's surface intercepting the power radiated into the solid angle, d OMEGA, from the source. The spreading factor has been isolated and accurately estimated by a ray-tracing computer program. Calculations have been performed for transmissions at 3 and 10 kHz and for three different ionospheric models using source altitudes ranging between 300 and 8000 km for some representative receiver point locations. Spreading factors were calculated both for direct and multiple hop waves in the earth-ionosphere waveguide. For low source altitudes (below about 2200 km) the coverage patterns of spreading-factor versus the receiver's geographic position showed well-defined peaks, indicating locally high radio fields. For higher altitudes the coverage patterns were broader but showed weaker maximum field strengths. A comparison was made with a simply estimated factor employed by Smith and Rorden, and quantitative and qualitative differences are noted. (auth)

30996 APPLICATION OF ELECTROACOUSTIC PROBE IN THE STUDY OF PLASMA DENSITY PROFILES AND OTHER PARAMETERS IN CYLINDRICAL PLASMA CLOUDS. Olin, J. G. (General Motors Inst., Flint, MI); Chen, K. M. Radio Sci.; 11: No. 2, 127-136(Feb 1976).

A new diagnostic method based on the excitation of thermal resonances using an electroacoustic probe has been developed to determine the electron density profile and other plasma parameters of a cylindrical warm plasma column. A coaxial electroacoustic probe is used to excite and detect the dipole and thermal resonances as the plasma density is varied. The electron density profile is expressed functionally in terms of unknown profile parameters. The profile and other parameters of the plasma column are then determined numerically based on some theoretical formulas and experimental results. (auth)

30997 TIME DEPENDENCE OF THE GEOMAGNETIC ACTIVITY INDEX A_p ON THE LUNAR PHASES. Apostolov, E. M. (Geophysical Inst., Sofia); Letfus, V. Bull. Astron. Inst. Czech.; 27: No. 2, 110-111(1976).

The effect of the moon on geomagnetic activity, represented by the diurnal values of the A_p-index, was investigated by a new method using cross-correlation analysis for the period 1960-1973. This time series was compared with an artificial cosine time series with the period T = 29.53058818 days and maxima at full moon. Average percentage deviations from the reference level of annual medians at a phase shift of +5.5 days, derived from the maximum of the cross-correlation function of the lunar phases and the A_p-index, were determined for the four principal phases of the moon. For the low activity period the maximum increase of the A_p-index amounts to +7.6% after full moon and the decrease to -7.3% after new moon. (auth)

30998 POTENTIAL OSCILLATIONS OF ISOLATED PLASMA LAYER. Eremin, I. M.; Shkelev, E. Izv. Vyssh. Uchebn. Zaved., Radiofiz.; 19: No. 1, 19-24(1976). (In Russian)

The potential oscillations of the isolated plane-parallel plasma layer under the conditions taking place near the head part of the Earth magnetosphere boundary or neutral layer of its tail are considered in the hydrodynamic approximation. Neglecting the influence of the magnetic field the dispersion equation of these oscillations is obtained for an arbitrary relation between the wavelength and the layer width. The analysis of this equation has been made. (auth)

30999 DISTRIBUTION OF INTRUDING LOW-ENERGY ELECTRONS IN THE EVENING-PREMIDNIGHT SECTOR ACCORDING TO KOSMOS-426 DATA. Rezhenov, B. V.;Vorob'ev, V. G.; Tsirs, V. E.; Lyatskii, V. B.; Pervaya, T. I.; Savin, B. I. Cosmic Res. (USSR) (Engl. Transl.); 13: No. 4, 467-472(1975).

Translated from Kosm. Issled.; 13: No. 4, 521-527(1975).

A study of the distribution of regions of intrusion of electrons with energies of 0.27, 11.0, and 28 keV relative to the boundaries of capture of electrons with E = (63 ± 16)keV is conducted on the basis of data of the Kosmos-426 satellite for the evening and pre-midnight sectors at different levels of magnetic activity. The results obtained are represented in the form of a diagram. (auth)

31000 GEOMAGNETIC CROCHETS ASSOCIATED WITH PROTON FLARES. Hanumath Sastri, J.; Suryanarayana Murthy, B.; Karunakaran, D. (Indian Inst. of Astrophysics, Kodaikanal, India). Indian J. Radio Space Phys.; 4: No. 1, 89-92(Mar 1975).

Magnetogram data of Kodaikanal for a 13-yr period from 1957 to 1969 have been examined for sfes (Crochets) associated with proton flares (PCA events). A study of these indicated that they are characterized by longer rise time and total duration, compared to those associated with normal flares. It is inferred from the range of values of α N that the region of enhanced conductivity is in the D region, below the normal electrojet. (auth)

31001 "BEST" ESTIMATES OF THE AMPLITUDES OF DIURNAL AND SEMIDIURNAL COMPONENTS OF Sq(H) AND THEIR ANNUAL VARIATIONS. Rangarajan, G. K. (Indian Inst. of Geomagnetism, Bombay). Indian J. Radio Space Phys.; 4: No. 1, 46-49(Mar 1975).

A semiannual oscillation of S_q(H) with its amplitude increasing with solar activity is shown to exist at Alibag also, indicating that this phenomenon is probably global as suggested by C. U. Wagner. Some characteristics of the variations are, however, shown to be different from those observed at median and high latitudes. A minimum in the amplitude of S_q(H) at Alibag is observed in September during low activity, which is absent during high solar activity. It is suggested that this feature is caused by the seasonal movement of northern S_q current focus. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

31002 ATOMIC PHYSICS. Rajam, J. B. New Delhi; Chand (1974). 1279p.

This book on "Atomic Physics" attempts to present in a clear and easy manner, a fairly comprehensive account of the salient features of the recent advances in the understanding of physical phenomena on the atomic scale. The various chapters in the book are devoted to the following topics: (1) discharge of electricity through gases, (2) the electron, (3) positive rays, (4) X-rays, (5) radioactivity, (6) the theory of relativity, (7) the quantum theory of radiation, (8) the wave nature of matter, (9) quantum statistics, (10) atomic models, (11) molecular spectra, (12) modern problems of radioactivity, (13) artificial transmutation, (14) cosmic rays and (15) structure and properties of the nucleus. (AK)

Beams and Their Reactions

Refer also to abstracts 30247, 30429, 30457, 30494, 31134, and 31963.

31003 (EUR-5234) LOW ENERGY ION-BEAM SPUTTERING AS A GENERALLY APPLICABLE SECTIONING TECHNIQUE IN MEASURING SOLID STATE DIFFUSION. Maier, K.; Schuele, W. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Dec 1974. 20p. (In German). INIS.

Sputtering equipment for the determination of extremely small diffusion coefficients in metallic materials and semiconductors is described. It is found possible to sputter atom layers from a few angstroms up to a few thousand angstroms over an area of about one square centimeter. Diffusion coefficients as small as 10^{-16} cm^2/sec are determined for copper with a precision of a few percent. The values obtained for this material in the higher temperature region (700°C) fit precisely to the values obtained by mechanical methods in the same temperature region. (auth)

31004 (IAEA-171, pp 23-66) ION-IRRADIATION, IMPLANTATION, AND CHANNELLING EFFECTS IN SOLIDS. Palmer, D. W. 1975.

From panel meeting on the utilization of low energy accelerators; Zagreb, Yugoslavia (30 Sep 1974).

In utilization of low energy accelerators. (International Atomic Energy Agency, Vienna (Austria)).

This review treats three particular but related aspects of the interactions with solids of ions having energies of a few times 10^4 eV to a few MeV. The aspects considered are respectively ion-irradiation, ion-implantation and ion-channelling effects, with descriptions of basic experimental and theoretical results, practical requirements and applications. Suggestions are made concerning research areas of special present and future interest in this field. (auth)

31005 (INIS-mf-1896, pp 113-136) TOTAL CROSS SECTIONS FOR ELECTRON SCATTERING BY NOBLE GASES. Chapter 4. Jansen, R. H. J.; de Heer, F. J. 7 May 1975.

This chapter is an abreviated version and contraction of two articles by the same authors, which will be published in Journal of Physics B (UK); 52 refs., 9 tables.

In elastic scattering of electrons by noble gas atoms and nitrogen molecules. (Amsterdam Univ. (Netherlands)).

Calculations are made of total cross sections for the scattering of electrons by noble gases by adding experimental total cross sections for ionization, excitation and elastic scattering and carried out for electron impact energies between 100 and 3000 eV. The accuracy of the total cross sections thus obtained is in the order of 10%. An extensive comparison with experimental, semi-empirical and theoretical data from literature is given. The use of total cross section in the application of dispersion relations is discussed.

31006 (INIS-mf-1937, pp 38-53) ANOMALOUSLY LARGE TRANSIENT FIELD THROUGH POLARIZED ELECTRON CAPTURE, Ch. 3. Eberhardt, J. L. 16 Jun 1975.

Thesis.

In magnetic moment measurement on very short-lived nuclear states in Megagauss transient magnetic fields. (Rijksuniversiteit Utrecht (Netherlands)).

Transient field precessions have been measured as a function of the initial ion velocity for ^{29}Si(2,+) in Fe to test velocity dependence of the Lindhard-Winther theory. An anomalous increase of the transient field was found at a high recoil velocity of v/e = 0.025. This increase is explained quantitatively by the capture of polarized Fe electrons into 2s vacancies in the moving ion. Earlier found discrepancies for ^{16}N, ^{18}O and ^{56}Fe are also discussed in terms of the proposed mechanism.

31007 (INIS-mf-1979, pp 9-40) CHAPTER 1. Meerts, W. L. 15 May 1975.

In properties of diatomic open-shell molecules by the molecular-beam electric-resonance spectroscopy. (Katholieke Universiteit Nijmegen (Netherlands)).

An experimental set-up for molecular beam electric resonance (MBER) spectroscopy has been described. The production of a strong suitable molecular beam especially of a series of short-living free radicals is discussed.

31008 (INIS-mf-1980) MOLECULAR BEAM STUDIES WITH A TIME-OF-FLIGHT MACHINE. Beijerinck, H. C. W. (Technische Hogeschool Eindhoven (Netherlands)). 5 Sep 1975. 179p. INIS.

5.2 velocity distribution and angular distribution of molecular beams from multichannel arrays published in Journal of Applied Physics, v. 46(1975) p. 2083; 138 refs., 54figs., 15 tables.

The study concerns the development of the time-of-flight method for the velocity analysis of molecular beams and its application to the measurement of the velocity dependence of the total cross-section of the noble gases.

31009 ION BEAM FOCUSING BY THE ATOMIC CHAINS OF A CRYSTAL LATTICE. Shulga, V. I. (Moscow State Univ.). Radiat. Eff.; 26: No. 1-2, 61-65(Sep 1975).

A study is made of the focusing of a parallel ion beam by a pair of close packed atomic chains of a crystal. The focal length of this system has been calculated to the approximation of continuous potential of chain in the general form and also for a number of specific potentials of ion-atom interactions. Ar ion beam focusing by a ⟨110⟩ Cu chain pair is discussed in detail. For this case, the focal length has been calculated as a function of ion energy using the method of computer simulation of ion trajectories in the chain field. The calculations were made on the basis of the Born-Mayer potential with various constants. A pronounced dependence of focal length on the constant in this potential has been found. (auth)

31010 FOCUSING OF CHARGED PARTICLE BEAMS BY QUADRUPOLE LENS DOUBLETS WITH CONSTANT VALUES OF THE RATIO OF THE FIELD PARAMETERS OF THESE LENS. Siksin, V. S. Prikl. Yad. Spektrosk.; No. 5, 203-207(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

A system is described for focusing a charged particle beam; the system consists of sector 90° deflecting magnets and quadrupole lens doublets. The dependences of the ion-optical value of the doublet-gas with respect to the image, the coefficient of angular magnification, and of the distance to the image on the field parameters of the lens were determined. The values obtained were graphed. The results obtained indicate how necessary it is to have a precise recovery of the change of the image position at the beam crossover, induced by the change in energy of the accelerator, and maintenance of a constant value of the energy resolution of the beam at the target. (JSR)

31011 ENERGY RESOLUTION OF A CHARGED PARTICLE BEAM BY SYSTEMS OF QUADRUPOLE LENSES. Siksin, V. S. Prikl. Yad. Spektrosk.; No. 5, 208-214(1975). (In Russian)

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The conditions affecting the value of the energy resolution of a charged particle beam passing a deflecting sector magnet and a system of quadrupole lens were previously established. In the present study the existence of a regularity in the change in the energy resolution of a charged particle beam by quadrupole lens was established and it was shown that this regularity can be applied to systems consisting of a large number of quadrupole lenses and other electronic lenses. (JSR)

31012 CLASSICAL SCATTERING USING THOMAS–FERMI TYPE INTERATOMIC POTENTIALS. Maheshwary, H. V.; Jain, A.; Auluck, F. C. (Delhi Coll.). Proc. Indian Natl. Sci. Acad., Part A; 39: No. 1, 48-53(1973).

The study of a Thomas-Fermi type potential was done through the computer calculation of classical scattering angles for the He ion and a gold target. The angles were plotted in the center-of-mass system for various incident energies ranging from 20 eV to 10 KeV. The results so obtained were compared with those having the Moliere potential with Robinson's (Phys Rev 1969, 179, 327) parameter. The plot was also given for Born-Mayer type potential (only one curve, though the computation was done for all the energies) with Abrahamson's new parameters. (auth)

31013 SPUTTERING OF Nb BY 12-MeV PROTONS. Ollerhead, R.W.; Mann, F.M.; Kneff, D.W.; Switkowski, Z.E.; Tombrello, T.A. (California Institute of Technology, Pasadena, California 91125). Phys. Rev. Lett. 36: No. 8, 439-442 (23 Feb 1976).

Sputtering yields for niobium bombarded by 12-MeV protons have been measured using a technique involving prior activation of the target material. Values obtained for backward and forward sputtering are $S_B = (1.6 \pm 0.1) \times 10^{-4}$ and $S_F = (4.7 \pm 0.3) \times 10^{-4}$, respectively. These values, expected to be similar to fast-neutron sputtering yields, are consistent with most recently published fast-neutron data. (auth)

31014 RELATIVE SPUTTERING YIELDS AND QUANTITATIVE SURFACE ANALYSIS BY AUGER SPECTROSCOPY. West, L.A. (Exploratory Materials Division, Sandia Laboratories, Livermore, California 94550). J. Vac. Sci. Technol. 13: No. 1, 198-203 (Jan 1976).

During the past few years, the qualitative analysis of surfaces by Auger electron spectroscopy has become an accepted analytical technique. With all analytical techniques, however, the ultimate goal is to obtain quantitative information. This paper presents data on the relative sputtering yield of several elements obtained by studying the surface composition of alloy systems (Cr–Pd, Ag–Pd, Cu–Pd, Mn–Ag–Pd, and Nb–U) varying in composition from a few to roughly fifty atomic percent. The reported measurements were taken while sputtering after the alloy surface had reached a steady state composition. Peak heights were referenced to *in situ* standards of the pure alloy components. Multiple determinations were carried out over a period of several weeks in order to check the reproducibility and to estimate the standard deviation in the data. This information was used to obtain uncertainty limits for the calculated sputtering yields. (auth)

31015 ELECTRON-STIMULATED PROCESSES AT SOLID SURFACES. Madden, H.H. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Vac. Sci. Technol. 13: No. 1, 228-232 (Jan 1976).

Surface analytic techniques that use incident electrons as the initial stimuli have, in many cases, been shown to be destructive. Examples of such destructive processes include the decomposition of chemisorbed species, stimulated surface reactions with gas-phase components, and the desorption of chemisorbed atoms. Since such processes reflect chemical changes in the surface under investigation, studies of these processes can yield useful surface information. In a review of some electron-stimulated surface reactions, the types of surface-chemistry information to be expected is discussed. Recent results of an electron-stimulated-desorption (ESD) investigation of the interaction of oxygen with Ni, W, and Mo surfaces are presented. Measurements of threshold values and of the energy distribution of ions desorbed for excitation energies near and well above threshold were made using potential-modulation techniques. A comparison is presented between these ESD results and soft-x-ray appearance potential measurements made on the same chemisorptive systems. (auth)

31016 CHARACTERIZATION OF SURFACES BY LOW-ENERGY HELIUM SCATTERING. Horne, J.; Miller, D.R. (Department of Applied Mechanics and Engineering Sciences, University of California at San Diego, La Jolla, California 92037). J. Vac. Sci. Technol. 13: No. 1, 351-354 (Jan 1976).

An experimental apparatus is described which permits excellent sensitivity and energy resolution in atomic and molecular beam surface scattering experiments. It is suggested that the Boxcar Integrator, a low cost, commercial instrument, is ideally suited to these experiments and, for helium scattering, yields more information than the conventional lock-in amplifier technique. Preliminary data on low-energy helium scattering from unoriented W(100) facets, produced by annealing a tungsten ribbon, shows sharp diffraction effects due to a surface structure grating at least 70 Å in characteristic size. Applications to inelastic scattering studies are briefly discussed. (auth)

31017 SEMICLASSICAL THEORIES AND QUANTUM HARDWALL CALCULATION OF ATOM SURFACE SCATTERING. Masel, R.I.; Merrill, R.P. (Department of Chemical Engineering, University of California, Berkeley, California 94720); Miller, W.H. J. Vac. Sci. Technol. 13: No. 1, 355-359 (Jan 1976).

A semiclassical formalism for atom and electron scattering from solid surfaces is presented and compared to exact quantum calculations for scattering from a sinusoidal hardwall and to experimental scattering distributions for thermal helium and neon beams scattered from W⟨112⟩. The helium results are well represented by elastic calculations, but large inelastic effects are evident in the neon scattering. The semiclassical calculations for the hardwall are in agreement with the exact quantum results to within a few percent. Qualitatively, either a specularly dominated distribution or a rainbow pattern is predicted, depending on the k vector and the amplitude of the surface periodicity. A preliminary attempt to apply this formalism to low-energy electron scattering from Ni(100) is also presented. The results, while not in exact agreement with more conventional dynamic LEED calculations, do reproduce absolute peak positions to within 7 V. (auth)

31018 COMPUTER SIMULATION OF SURFACE ATOM EJECTION BY ION IMPACT. Helbig, H.F. (Clarkson College of Technology, Potsdam, New York 13676). J. Vac. Sci. Technol. 13: No. 1, 368-373 (Jan 1976).

The mechanisms for ejecting atoms from a solid surface subjected to ion bombardment are generally very complicated. However, the most energetic sputtered atoms must result from incident ions which enter the solid and, after relatively few collisions, return to impact with a surface atom. The velocity spectrum of scattered and ejected atoms has been calculated using a three-dimensional computer simulation. The trajectories, taken as a series of binary encounters, were computed rapidly by using a parametrized analytic form relating impact parameter, energy, and deflection angle. The parameters were obtained from a representative sample of trajectories computed by numerical intergration of the dynamical equations using an 8–4 interaction potential. The trajectories were followed for 1500-eV Ne^+ ions entering a (111) surface of a gold crystal at 45° to the surface normal. To simplify the calculations, ions passing to a depth greater than the third atomic plane were considered lost. For ions returning to the surface, the recoil velocities which they produce in the surface atoms were computed and sorted to produce the desired ejection-velocity spectrum. The velocities of ions emerging from the surface were treated similarly to obtain the spectrum of scattered velocities. (auth)

31019 ENERGY DEPENDENCE OF SCATTERED ION YIELDS IN ISS. Rusch, T.W.; Erickson, R.L. (Central Research Laboratories, 3M Company, St. Paul, Minnesota 55133). J. Vac. Sci. Technol. 13: No. 1, 374-377 (Jan 1976).

Scattered ion yields as a function of primary ion energy in the range from 200 to 2500 eV have been measured for He^+, Ne^+, and Ar^+ scattering from a variety of solid surfaces. The energy dependence of these yield curves contains information about the electronic states of surface atoms which complements normal ISS data. In addition, changes in the surface-atom chemical environment can be manifested as changes in the yield curve. A preliminary classification of yield curve shapes is proposed based on two considerations. First, does the target atom have an electronic state with a binding energy within approximately ±10 eV of the bombarding species' first ionization potential? Second, if the first criterion is satisfied, what are the orbital symmetries of this electronic state and the vacant ionic state? (auth)

31020 REDEPOSITION OF SPUTTERED SPECIES BY THE ELECTRIC FIELDS OF AN INCIDENT ION BEAM AND SPUTTERED ION. Helbig, H.F.; Adelmann, P.J.; Miller, A.C.; Czanderna, A.W. (Department of Physics and Institute of Colloid and Surface Science, Clarkson College of Technology, Potsdam, New York 13676). J. Vac. Sci. Technol. 13: No. 1, 379-383 (Jan 1976).

To explain the recently observed redeposition of sputtered Au, Ag, and Cu, it is shown here that low energy ions sputtered from a plane metallic surface by an obliquely incident ion beam can be returned to the surface by the electrostatic fields of the beam and of the image charges of the sputtered ions. Trajectories for sputtered Au ions were obtained by numerical integration of the equations of motion. The ion image force dominates the motion near the plane ($< 10^5$ Å) but can produce significant redeposition only within a few hundred Å of the ion ejection points. However, the field due to the ion beam (0.1-50 V/m) can produce redeposition at distances of up to 2 cm, where the effect was observed. Using this beam force model, the redeposition density should diminish if the beam charge density is decreased, and this has been verified by measuring the fractional coverages of redeposited gold ranging from 0.014 to 0.056 monolayers with ion scattering spectrometry. The model also predicts the general decrease in redeposition intensity in a circular plane with the sputtering source on the circumference. Absolute differences in intensity between the experimental and normalized calculated values may result from distortions in the actual electric fields compared with the model, from different velocity distributions of the sputtered ions, or possibly, from additional redeposition by other mechanisms. Based on the present calculations, it is estimated that 0.1% to 1% of the sputtered gold atoms are ionized and that 2% to 3% of these ions are redeposited in the region considered. (auth)

31021 ABSTRACT: NEUTRON SPUTTERING FROM METAL FOILS. Thomas, M.T.; Harling, O.K.; Brodzinski, R.L.; Rancitelli, L.A. (Battelle-Northwest, Richland, Washington 99352). J. Vac. Sci. Technol. 13: No. 1, 429-429 (Jan 1976).

Experiments to determine the material removed (sputtering) from the surfaces of metal foils during irradiation with 14.8 MeV (d, t) neutrons will be described. Neutron activation analysis was used to measure the sputtered material. This is an integral technique which determines quantitatively the number of atoms on the collector. Six experiments were done using the Lawrence Livermore Laboratories rotating target (d, t) neutron source and one experiment was done at the (d, Be) source at the University of California, Davis. In each experiment a large number of collector–target assemblies were located at various distances from the neutron source. The collector–target assemblies were housed in a stainless steel ultrahigh vacuum system and all irradiations were

p[illegible]med in a high-vacuum environment [$\sim 1\times10^{-7}$ torr to 5×10^{-9} torr ($\sim 1.3\times10^{-5}$ Pa to 6.5×10^{-7} Pa)]. For these experiments the mean (*d, t*) neutron energy was 14.8 MeV in the forward direction, and for the different beam-on times and various source to sample distances the target fluences ranged from 1×10^{14} to 2.6×10^{16} (*d, t*) n/cm^2. A (*d*, Be) source is highly anisotropic and is peaked in the forward direction. For the 20μA, 40 MeV deuteron beam used at the University of California, Davis, the average (*d*, Be) neutron energy was about 15 MeV, and at the point of closest approach to the Be target fluxes of $\sim 2\times10^{13}$ n/cm^2 s are produced.

Neutron sputtering yields were obtained for niobium and gold. Collectors for all of the niobium and gold targets were 2.54-cm diameter, single- or polycrystal wafers made from 9N pure silicon ingots. In all cases the gold targets consisted of Marz grade foils 2.54 cm in diameter and 0.0127 cm thick, vacuum annealed, and etched in aqua regia. The niobium targets were also prepared from high-purity commercial grade material but had a wide variety of metallurgically different surface preparations. Except for the single crystals all the Nb samples were in the form of foils. Some were completely cold worked while others were vacuum annealed. Surface preparations varied from just chemical etching, to mechanical polishing and etching, and mechanical polishing and electropolishing. In this way a large range of surface topographies was produced. In all, collectors from 25 niobium samples covering 7 irradiations were examined using slow neutron activation analyses. About one-third of the collectors had no measureable ^{93}Nb. Analyses of the niobium yield data as a function of neutron dose gave a zero slope. This means that our data give upper bounds for the sputtering yields and our best estimate of the neutron sputtering ratio for niobium is $\leqslant 1\times10^{-5}$ atoms/neutron. Micrometer size niobium particles were not found even after extensive search with a scanning electron microscope equipped with energy dispersive x-ray analysis. Table I is a summary of the secondary-emission monitor (SEM) studies. Statistical studies of the neutron activation analyses of the gold data show a linear relationship between the gold yield and neutron dose. Also, there is a significant gold background on the collectors. The best estimates of (*d, t*) neutron gold sputtering ration are $\sim 1.5\times10^{-5}$ atoms/neutron in the forward direction and $\sim 1.0\times10^{-5}$ atoms/neutron in the backward direction. Details of these experiments and data analyses will be submitted for publication in the *Journal of Applied Physics* or *Physical Review*. (auth)

31022 ABSTRACT: (D, T) NEUTRON RADIOACTIVE SPUTTERING YIELDS. Thomas, M.T.; Harling, O.K.; Brodzinski, R.L.; Rancitelli, L.A. (Battelle-Northwest, Richland, Washington 99352). J. Vac. Sci. Technol. 13: No. 1, 447-448 (Jan 1976).

(D, T) neutrons have sufficient kinetic energy for various nuclear reactions such as (n,α), (n,p), and ($n,2n$) to occur. A series of experiments have been performed using a 14.8 MeV (*d, t*) neutron source in which the radioactive daughters ejected from the near surface region of the target material have been collected and measured. The geometry of the experimental arrangement was such that radioactive daughters ejected in the forward direction (neutron current direction) and backward direction were collected. For example, the forward radioactive sputtering ratio for ^{92m}Nb produced by the ^{93}Nb($n,2n$) reaction from cold-worked niobium foil is (1.06 ± 0.06) 10^{-7} radioactive atoms/neutron, and the backward sputtering ratio for ^{92m}Nb is $(7.58\pm1.09)10^{-10}$ atoms/neutron. For annealed gold the forward sputtering ratio for ^{196}Au produced by the ^{197}Au(n, $2n$) reaction is $(1.05\pm0.06)10^{-7}$ atoms/neutron, and the backward sputtering ratio for ^{196}Au is $(2.83\pm0.09)10^{-9}$ atoms/neutron. These sputtering ratios are the slopes of measured yields versus measured fluence curves and are obtained by a linear least-squares fit to the data. The quoted errors are the standard deviations calculated by the linear regression routine. Figure 1 is a bar graph summary of the forward radioactive sputtering ratios obtained for a large variety of metals and also for 316 stainless steel. The graph includes the reaction producing the radioactive recoil and the half-life of the radioactive daughter. It can be seen that the sputtering ratio for all of the materials studied range from the mid-10^{-8} to mid-10^{-7} atoms/neutron range. We have not observed any statistical differences in the radioactive sputtering ratios between annealed and cold worked niobium or between annealed and cold worked 316 stainless steel. In addition, it is possible to determine an effective emission range of the radioactive recoil. Since the metal targets used in the experiments are thicker than heavy-ion ranges in metals, an effective emission range can be defined simply as the product of the ratio of the number of radioactive recoil atoms on the collector to the number of recoil atoms in the target and the thickness of the foil. As an example, the forward effective range of the ^{92m}Nb recoil ion in niobium is 410 Å, while the backward effective range is only about 3 Å. For such small ranges, elemental surface and near surface composition such as oxide and carbide layers may produce errors in the results because of uncertainties in the parent atom density.

Complete details of this experiment and data analysis are being submitted to *Physical Review* or the *Journal of Applied Physics*. (auth)

31023 SCATTERING OF THERMAL HELIUM BEAMS FROM HIGH MILLER INDEX (STEPPED) PLATINUM CRYSTAL SURFACES. Ceyer, S.T.; Gale, R.J.; Bernasek, S.L.; Somorjai, G.A. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). J. Chem. Phys. 64: No. 5, 1934-1940 (1 Mar 1976).

Helium beams generated by a 300 K source were scattered from single crystal platinum surfaces. The angular distribution of the scattered beam was monitored as a function of azimuthal angle ϕ and incident angle θ_i. The effect of the presence of atomic steps on the angular distribution of scattered helium atoms was studied on a crystal surface composed of terraces on the average five atoms in width separated by steps of monatomic height. Rainbow scattering is observed when the steps are oriented perpendicular to the incident beam direction indicating strong modulation of the angular distribution by the periodic step potential. Only specular scattering is observed when the incident beam impinges on the crystal along the step edges which indicates minimal effects of the presence of steps on the scattering distribution. These results as well as the absence of diffraction are in good agreement with previous theoretical calculations. (auth)

31024 CHARGE-STATE DETERMINATION OF BEAM-FOIL SPECTRAL LINES. Oona, H.; Bickel, W.S. (Department of Physics, University of Arizona, Tucson, Arizona 85721). J. Opt. Soc. Am. 66: No. 3, 278-280 (Mar 1976).

Photoelectric recording of completely separated charge-state beams to give unambiguous and rigorously correct charge-state identifications is described and compared to alternative techniques. (auth)

31025 THERMIONIC EMITTER OF LANTHANUM STRONTIUM VANADATES. Sayer, M. US Patent 3,944,866. 8 Apr 1974. vp.

A thermionic emitter for electron beam apparatus is described comprising a metallic, electrically conducting support structure and a shaped piece of electron emitting material mounted on and in electrical contact with the said support structure, said material being the compound lanthanum strontium vanadate having the formula La/sub (1-x)/Sr/sub x/ VO_3 where x is the fraction of strontium (Sr) incorporated in the La VO_3 and with x lying between 0.01 and 0.4.

31026 PLASMON EXCITATION ENERGIES IN ZnO, CdO, AND MgO. Hengehold, R. L. (Air Force Inst. of Tech., Wright-Patterson AFB, OH); Pedrotti, F. L. J. Appl. Phys.; 47: No. 1, 287-291 (Jan 1976).

A study has been made to experimentally determine the plasmon excitation energies in the oxides of Zn, Cd, and Mg using the reflection electron energy loss technique. The measurements were made on clean single-crystal surfaces using electrons of 250–1000 eV energy. Distinction was made between surface- and bulk-plasmon excitation by recording the changes which occurred in the energy loss spectrum as the surface was selectively contaminated. Surface-plasmon excitation energies of 17.0, 15.9, and 14.7 eV and bulk-plasmon excitation energies of 18.8, 22.8, and 22.0 eV were measured for ZnO, CdO, and MgO, respectively. Comparison is made with similar data obtained from optical reflectivity and transmission electron energy loss measurements. (auth)

31027 LASER DIAGNOSTIC IN MOLECULAR BEAMS. Bergmann, K.; Demtroeder, W.; Hering, P. (Trier-Kaiserslautern Univ., Kaiserslautern (F.R. Germany). Fachbereich Physik). Appl. Phys.; 8: No. 1, 65-70 (Sep 1975).

The output from a stabilized, tunable single-mode laser is split into two beams which cross the molecular beam perpendicularly and at an angle of β to the beam axis. Turning the laser frequency across the unshifted and Doppler-shifted absorption profile of the molecular transition yields the velocity distribution of the molecules in the beam for individual quantum states. The internal state distribution among vibrational and rotational levels in the beam can be determined by comparing the fluorescence simultaneously induced in the beam and in a cell with molecules in thermal equilibrium. (DE)

31028 POLARIZED ION SOURCES. Jahan Singh (Punjab Univ. R.P.G. Coll., Rahtak (India)). Phys. News.; 5: No. 4, 139-143 (Dec 1974).

A brief description is given of the spin orientation aspects and polarization phenomena in nuclei at rest and in beams. The scattering of an unpolarized beam by a target results in a polarized beam and the measurement of polarization requires further scattering by a second target. The double scattering can be avoided by starting with polarized beams. It is pointed out that a polarized beam of nuclei obtained by the interaction between atomic moments and external magnetic field can be used for nuclear reaction studies with single scattering only. These are known as polarized ion sources and they have several advantages over the double

scattering methods. A method successfully developed to produce polarized ion beam using deuterium atoms is described. The polarized ion beam is injected into an accelerator and used for nuclear studies such as stripping reactions, measurement of asymmetry parameter, phase shift analysis etc. (AK)

31029 MEASURING THE BEAM CURRENT DENSITY DISTRIBUTION OF 1 MeV ELECTRONS SCATTERED BY A FOIL AND AIR. Klimov, S. V.; Kon'kov, N. G.; Krylov, S. Yu. pp No. 7 p.41-45 of Radiation Technology. Proceedings of VNIIRT. Moscow; Atomizdat (1972). (In Russian)

31030 GENERATION AND STORAGE OF MULTIPLY-CHARGED IONS WITHIN A RF QUADRUPOLE TRAP. Moeller, P. A.; Pham Tu Manh; Schwebel, C.; Septier, A. (Univ., Paris). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 991-993(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A three-dimensional rf quadrupole field trap was designed for generation of multiply-charged ions by successive electron impacts, and for studies of physical processes occurring during charge transfers. Op 'mum operating conditions were derived from theoretical considerations, and preliminary experimental results are given. At the end, some limitations and prospects of the quadrupole trap as a tool for physical investigations are briefly discussed. (auth)

31031 USE OF THE HOT-ELECTRON MIRROR MACHINE INTEREM AS A HIGH-Z ION SOURCE. Tamagawa, H. (Nagoya Univ., Japan); Alexeff, I.; Jones, C. M.; Miller, P. D. IEEE Trans. Nucl. Sci.; NS-23: No. 2, 994-998(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Production of the high-Z charge states in helium, nitrogen, and argon was measured in the INTEREM device at the Oak Ridge National Laboratory. The INTEREM device contains a hot electron (approximately 500 keV) plasma trapped in a minimum B geometry. The device is of interest because its parameters, electron density and energy, and ion lifetime are consistent with those required for the production of highly charged ions. Ion charge and ion energy spectra were measured independently using an einzel lens type energy analyzer combined with a quadrupole mass filter. For helium, most of the ions were doubly charged under proper operating conditions. For nitrogen, the ion yield was found to be peaked at Q equals 4, and under these conditions the yield at Q equals 6 was down by a factor of about 20. Energy distribution curves for different charge states show interesting features, from which important information may be inferred about the plasma in INTEREM. Although discrepancies exist in the ion yields one concludes that an INTEREM-like device employing a minimum B geometry and electron cyclotron resonance heating may be expected to be a good high-Z ion source. (auth)

31032 ELECTRON-CYCLOTRON-RESONANCE PLASMA AS A SOURCE OF MULTIPLY CHARGED IONS. Bernhardi, K.; Fuchs, G.; Goldman, M. A.; Herbert, H. C.; Walcher, W.; Wiesemann, K. (Univ., Marburg, Ger.). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 999-1005(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The properties of an electron-cyclotron-resonance (ECR) plasma (3 cm microwaves up to 2.4 kW) were investigated. A total of 80 mu A noble gas ion current was extracted from a 1 mm dia. hole so far. The charge state distributions show a maximum above the 1+ state, indicating that multiple impact ionization is a dominant process. X-ray spectra, sheath potential and microwave reflection were measured to gain some physical understanding of the discharge. The applicability of the device as an ion source is discussed. (auth)

31033 LASER-INITIATED VACUUM ARC FOR HEAVY ION SOURCES. Hirshfield, J. L. (Yale Univ., New Haven). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1006-1007(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Laser-triggered discharges were considered for some time both for electron and ion sources. It was recently shown that conventionally triggered metal-vapor arcs can sustain even higher ion currents. It is pointed out that laser initiation permits arc operation in a high-current regime, and with geometry attractive for heavy ion sources. Preliminary data are presented on laser-initiated vacuum arcs using carbon, copper, and tungsten cathode electrodes. Discharge current pulses of over 10^4 amperes with durations of up to 1 msec were employed to yield fully ionized source plasmas of liters volume with ion densities greater than $10^{13}cm^{-3}$. Electrode erosion rates were in the range of 10^{-4} gm/C (the same order as in vacuum arcs) corresponding to ion injection currents in the range of 10^3 amperes. (auth)

31034 H^- FORMATION PROCESSES OF INTEREST TO ION SOURCE DEVELOPMENT. Olson, R. E. (Stanford Research Inst., Menlo Park, CA). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 971-974(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The results of several cross section calculations on systems that are of interest to ion source development are summarized. The descriptions of the theoretical procedures used will be extremely limited. A series of H + Cs reactions, H(2s) + Ar, Kr, Xe cross sections, and some H^+ + Hg calculations are discussed. (auth)

31035 VUV-SPECTROSCOPY OF MULTIPLY CHARGED ION SOURCE-PLASMAS. Bruck, M.; Bruckmueller, R.; Hertenberger, G.; Winter, H. (Technische Univ., Vienna). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 967-970(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The ion charge state distribution (CSD) in a multiply charged ion source- (MCIS-) plasma can be determined from the spectrum of resonance transitions of excited neutral and ionized plasma particles. The principle of this method, which for noble gas ions involves vacuum-ultraviolet spectroscopy, is described and first measurements for a DUOPLASMATRON-ion source operated with He and Ar are presented. (auth)

31036 SPUTTERING AND ION-SOURCE TECHNOLOGY. Andersen, H. H. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 959-966(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Sputtering is dependent on a number of projectile and target parameters. It is shown that the dependence of the sputtering yield on projectile energy, angle of incidence and atomic number is well understood. Also, the dependence on the bulk properties of the target is described reasonably well by theory, while the dependence on the actual surface topography of the target is difficult to quantify. Positive-ion sources mainly depend on the number of atoms sputtered per incoming ion (sputtering yield), while also energy- and angular-distributions of the sputtered material are of primary importance for negative-ion sources. These distributions are reasonably well known and allow a direct calculation of the emittance of some negative-ion sources. (auth)

31037 ATOMIC ELECTRON AFFINITIES. Lineberger, W. C. (Joint Inst. for Laboratory Astrophysics, Boulder, CO). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 934-935(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

New binding energy information is presented for P^3 and Fe^4. A table is given showing the recommended electron affinities for the ground state atom of the main body of the periodic table and the three long series. (JFP)

31038 ELECTRON AFFINITIES: THEORETICAL. Kaufman, J. J. (Johns Hopkins Univ., Baltimore). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 936-946(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A brief description is given of the conceptual background and formalism of the various ab-initio and semi-ab-initio quantum computational techniques for calculating atomic and molecular electron affinities: Hartree–Fock–Roothaan SCF, configuration interaction (CI), multiconfiguration SCF (MC-SCF), Bethe–Goldstone, superposition of configurations (SOC), ab-initio effective core model potentials, X alpha-MS, plus other less common methods. Illustrative and comparative examples of electron affinities calculated by these various methods are presented. (auth)

31039 BEAM FORMATION AND SPACE CHARGE NEUTRALIZATION. Green, T. S. (Culham Lab., Abingdon, Eng.). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 918-928(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Two aspects of the determination of the optical quality of ion beams are considered: namely, the formation of an ion beam by extraction from a plasma source and the space charge neutralization of ion beams. It is noted that there is a relation between these problems since they both depend on the perveance of the beam and become more important as the perveance increases. (JFP)

31040 BACKSCATTERING OF He^+ AND H^+ PARTICLES FROM ULTRA THIN FILMS IN THE ENERGY RANGE 50 TO 100 keV. Goldberg, H. J. Manhattan, KS; Kansas State Univ. (1975). 93p. University Microfilms Order No. 76-2930.

Thesis (Ph. D.).

To test the applicability of the potential arising from Lindhard's Thomas–Fermi treatment of the interaction between two atoms, the elastic collision cross sections of He^+ and H^+ ions incident on targets of Au, Ag, Cu, Bi, Ni, and In were measured. The ions were accelerated to energies ranging from 50 to 100 keV and were made to collide with the target material. Those ions that had been scattered through a laboratory angle of 150^0 were detected and energy analyzed. The results obtained clearly illustrate the efficacy of the Lindhard description for elastic collisions in this energy range. In addition, they further show that fractional monolayer vacuum evaporated targets can be used for these measurements. (Diss. Abstr. Int., B)

31041 APPARATUS FOR GENERATING AN ELECTRON BEAM. Hashmi, Z. (to Ford Motor Co. of Canada, Ltd., Oakville, Ontario). Canadian Patent 968,469. 27 May 1975. 10p.

Available from Commissioner of Patents, Ottawa.

Apparatus for use in generating an electron beam within an evacuated envelope is described. The envelope has a definable imaginary axis about which a plurality of thermionically emissive electrodes are positioned. Spaced from the electrodes is an extractor and/or anode for collecting electrons. A conductive plate positioned on the axis is provided for reflecting electrons and for attracting positive ions. Magnetic coils are provided for producing a magnetic field within the envelope between the thermionically emissive electrodes and the extractor or anode.

31042 MEASUREMENT OF LOW INTENSITY ELECTRON OR NEGATIVE ION BEAMS. Inglebert, R. L.; Viaris de Lesegno, P. (Paris-13 Univ., 93 - Saint-Denis (France)). Rev. Phys. Appl.; 10: No. 5, 339-340(Sep 1975). (In French).

An electronic system is presented by which low energy negative ion or electron beams of weak intensity can be measured. The set up includes an analog-digital converter, photocouplers and a digital analog converter; it is connected to the output of an electron multiplier and allows the return to earth of the reference potential. Mass spectra of negative ions are thus obtained with a quadrupole mass spectrometer. (FR)

31043 ION SPUTTERING OF ALLOYS. Pickering, H.W. (Metallurgy Section, Department of Material Sciences, The Pennsylvania State University, University Park, Pennsylvania 16802). J. Vac. Sci. Technol. 13: No. 2, 618-621 (Mar 1976).

Based on an idealized model of ion sputtering of a binary alloy which consists of an easy-to-sputter and a difficult-to-sputter metal, a mass transfer calculation was carried out. Solutions for both the initial transient and subsequent steady-state concentration profiles, and the excess (sputtered) amounts of the easy-to-sputter component were obtained. For typical sputtering rates it is found that the sputtering enhanced diffusivity must be $\gtrsim 10^{-17}$ cm^2 s^{-1} before an interdiffusion zone can form. The analysis is of special significance since it shows that even when the alloy components have greatly different sputtering tendencies: (a) nonpreferential sputtering is always obtained after an induction period, the latter of which depends on the effective alloy interdiffusivity and the over-all rate of sputtering and (b) the attainment of nonpreferential sputtering requires that the new surface continuously readjusts its composition in the direction of enriching in the difficult-to-sputter component. Similar results may be expected for oxides. (auth)

31044 COMPARISON OF CALCULATED ATOMIC STOPPING-POWER OSCILLATIONS WITH APPARENT FLUCTUATIONS IN MEASURED NUCLEAR LIFETIMES. Latta, B.M.; Scanlon, P.J. (Department of Physics, Queen's University, Kingston, Ontario, Canada K7L 3N6). Phys. Rev. A 13: No. 4, 1370-1380 (Apr 1976).

Reported measurements by Broude *et al.* of the lifetime of the 3.34-MeV nuclear state in ^{22}Ne, determined by Doppler-shift measurements on the γ decay of the excited nucleus as it is slowed down by various absorbers, show an oscillatory structure that can be attributed to oscillations in the electronic stopping cross section (S_e) of the absorbers. Unlike previously observed oscillations in S_e, which were for channeled or forward-scattered particles, these are oscillations in the average value of S_e. We have considered the problem in terms of an extension of the Lindhard-Scharff-Winther (LSW) theory to low-velocity heavy ions. We find that in the LSW formalism the appropriate effective charge for the projectile is not simply related to conventional equilibrium charge distributions, for velocities corresponding to those in the nuclear lifetime measurements. Despite this, it is possible to obtain relative stopping powers, at a given velocity, which are strongly correlated with the apparent oscillations in the value of the nuclear lifetime. (auth)

31045 INFLUENCE OF SURFACE ROUGHNESS ON THE INTENSITY OF ELASTICALLY SCATTERED LOW-ENERGY NOBLE-GAS IONS. Nelson, G.C. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 47: No. 4, 1253-1255 (Apr 1976).

The influence of surface roughness on the intensity of elastically scattered low-energy noble-gas ions has been determined for surfaces whose surface displacements are normally distributed. This has been done by modeling the effect of shadowing on the scattered-ion intensity. The experimental results are in good agreement with the values predicted by the model. (auth)

31046 ANGULAR DEPENDENCE OF OSCILLATORY STRUCTURE IN LOW-ENERGY ION-SURFACE SCATTERING. Tolk, N.H.; Tully, J.C.; Kraus, J. (Bell Laboratories, Murray Hill, New Jersey 07974); White, C.W.; Neff, S.H. Phys. Rev. Lett. 36: No. 13, 747-750 (29 Mar 1976).

Measurements have been performed of the dependence on scattering angle and target orientation of the oscillatory structure recently observed in low-energy ion scattering from surfaces. Wide variation is exhibited in the behavior of oscillation maxima as a function of scattering angle depending on the target species studied. A semiquantitative model is presented which treats the phenomenon in terms of quantum mechanical phase interference between pairs of near-resonant quasimolecular levels. (auth)

31047 RAPID DETERMINATION OF THE OVERLAP INTEGRAL IN A MERGING BEAMS SYSTEM. Nitz, D.E.; Geis, M.W.; Smith, K.A.; Rundel, R.D. (Department of Space Physics and Astronomy, Rice University, Houston, Texas 77001). Rev. Sci. Instrum. 47: No. 3, 306-310 (Mar 1976).

A method for determining the beam overlap integral semiautomatically in a merging beams experiment is presented. The apparatus consists of a driven beam scanner and an analog circuit which computes two-dimensional overlap integrals from the sampled beam currents. Only a simple additional computation is required to obtain the three-dimensional overlap integral. Results of qualitative and quantitative tests demonstrate the validity of the technique. The capability for rapid measurement of beam overlap is employed to investigate the stability of the overlap integral. (auth)

31048 DETECTION OF LiH AND NaH MOLECULAR BEAMS BY LASER FLUORESCENCE AND MEASUREMENT OF RADIATIVE LIFETIMES OF THE $A\,^1\Sigma^+$ STATE. Dagdigian, P.J. (Department of Chemistry, The Johns Hopkins University, Baltimore, Maryland 21218). J. Chem. Phys. 64: No. 6, 2609-2615 (15 Mar 1976).

We report here detection of supersonic molecular beams of LiH and NaH using the tunable laser fluorescence technique. From measurement of the relative intensities of individual rotational lines in the excitation spectrum, beam rotational temperatures $T_{rot} = 600 \pm 100$ °K for LiH and $T_{rot} = 230 \pm 50$ °K for NaH have been obtained. Direct measurement of the fluorescence decay of excited $A\,^1\Sigma^+$ state molecules after pulsed laser excitation has allowed determination of the radiative lifetimes of several (v,J) levels. We find τ $(v=2,J=3) = 29.4 \pm 1.3$, τ $(v=5,J=3) = 30.5 \pm 1.3$, and τ $(v=7,J=12) = 36.9 \pm 1.9$ nsec for ^7LiH and τ $(v=8,J=3) = 22.7 \pm 1.6$ nsec for ^{23}NaH, where the quoted uncertainties represent three standard deviations. These values agree to within the ~10% quoted experimental uncertainties with theoretical lifetimes calculated using *ab initio* electronic transition moments of Docken and Hinze (LiH) and Sachs, Hinze, and Sabelli (NaH). (auth)

31049 SYNCHROTRON RADIATION AS A NEW TOOL WITHIN PHOTON-BEAM TECHNOLOGY. Doniach, S.; Lindau, I.; Spicer, W. E.; Winick, H. (Stanford Univ., CA). J. Vac. Sci. Technol.; 12: No. 6, 1123-1127(1975).

From 13th symposium on electron, ion, and photon beam technology; Colorado Springs, CO, USA (21 May 1975).

Synchrotron radiation is now playing an increasingly important role in recent developments of new light sources. Synchrotron light emitted from a relativistic electron beam has a radiation pattern which makes it a unique source. The advantages with this type of radiation can be summarized as (a) continuous spectrum extending from the ir to the x-ray region, (b) strongly polarized, (c) highly collimated, (d) pulsed structure allowing time-resolution spectroscopy, and (e) high intensity making feasible the use of monochromators with narrow band pass. The Stanford Synchrotron Radiation Project has been in operation since May 1974 as a U. S. National Facility for uv and x-ray research in many disciplines using the radiation from the storage ring SPEAR at the Stanford Linear Accelerator Center. The radiation spectrum is characterized by the critical energy which varies as E^3 (E equals electron-beam energy) and is 11 keV for E equals 4 GeV. Useful flux is available out for approximately five times the critical energy. Five monochromators now share the beam run and cover the entire wavelength region from the visible to the hard x-ray region. Several experimental groups are involved in research programs including (a) uv and x-ray photoelectron spectroscopy, (b) optical reflectance and transmission studies, (c) soft x-ray absorption and extended x-ray absorption fine structure (EXAFS) studies, (d) low-angle scattering studies of certain biological materials, and (e) x-ray diffraction studies of protein crystals and other materials. (auth)

31050 THICKNESS DETERMINATION OF ULTRATHIN FILMS BY AUGER ELECTRON SPECTROSCOPY. Holloway,

P. H. (Sandia Labs., Albuquerque, NM). J. Vac. Sci. Technol.; 12: No. 6, 1418-1422(1975).

From 13th symposium on electron, ion, and photon beam technology; Colorado Springs, CO, USA (21 May 1975).

The feasibility of using Auger electron peak-height ratios for film thickness determination has been demonstrated for ultrathin films of chromium oxide on gold substrates. The range of equivalent film thicknesses determined was from 3 to 67 A, but the technique can measure thicknesses up to approximately 100 A. Using peak-height ratios from Auger electrons of different energies, the uniformity of the chromium oxide film was demonstrated. It was also demonstrated that argon-ion sputtering removed the chromium oxide in a nonuniform manner. The mean free path lengths of 70-, 527-, and 2024-eV electrons in chromium oxide were determined to be 4.3, 14, and 28 A, respectively. (auth)

31051 REVIEW OF SPUTTER NEGATIVE ION SOURCES. Middleton, R. (Univ. of Pennsylvania, Philadelphia). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1098-1103(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A brief account of cesium sputter ion sources is presented with particular emphasis being placed on sources that use a cesium beam as the sputter agent. Some thoughts are also presented on the mechanism whereby negative ions are formed by the sputtering of low work function surfaces. The possibility of increasing negative ion yields still further by the depostion of additional neutral cesium or some other alkali metal is discussed.

31052 EMITTANCE MEASUREMENTS ON NEGATIVE ION SOURCES. Doucas, G.; Greenway, T. J. L.; Hyder, H. R. M.; Knox, A. B. (Oxford Univ.). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1155-1161(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

An automated system was developed for measuring the emittance of beams from negative ion sources. The data are stored as two-dimensional spectra in a kicksorter and subsequently analyzed with a PDP-10 computer. The system was first used to measure the properties of, and assess the value of design changes to, a Middleton sputter source. Subsequently, the emittance of several different types of negative ion source were compared. A retarding field energy analyzer of high resolution was used to measure the beam energy spreads from the Middleton sputter source and from other negative ion sources, including a direct extraction duoplasmatron and a sputter Penning source. Typical spectra have a width of a few eV, with a small group of higher energy ions.

31053 INTERACTION OF A HIGH-CURRENT RELATIVISTIC BEAM WITH A SLOW-WAVE STRUCTURE. Gapanovich, V. G.; Lebedev, A. N. (Lebedev Inst. of Physics, Moscow). Sov. Phys.–Tech. Phys. (Engl. Transl.), 20: No. 4, 532-536(Jul 1975).

Translated from Zh. Tekh. Fiz.; 45: No. 4, 844-851(Apr 1975).

The longitudinal interaction of a high-current relativistic electron beam with an iris-loaded waveguide slow-wave structure is analyzed. A self-consistent system of equations for the amplitudes and phases of the radiation-field harmonics is obtained through an expansion of the field in eigenmodes. The instability growth rates are calculated in the linear approximation. The nonlinear stage of the interaction is analyzed numerically for a monoenergetic beam in the single-mode approximation. Particles are trapped by the wave in the nonlinear stage of the interaction so that the instability is stabilized. An analytic model for the beam consisting of a chain of charged discs is discussed on the basis of the trapping and associated bunching of the beam. The maximum amplitude and beat period of the radiation field are calculated. (auth)

31054 SPECTRAL CHARACTERISTICS OF THE IONS Er^{3+} AND Ho^{3+} IN THE LATTICE OF $GdAlO_3$ DURING ELECTRON EXCITATION. Arsen'ev, P. A.; Khasan, Kh. V.; Chukichev, M. V. Zh. Prikl. Spektrosk.; 23: No. 4, 725-729(Oct 1975). (In Russian)

Studies were made of the cathodoluminescence spectra of crystals activated with the ions Er^{3+} and Ho^{3+}. Measurements were made of the lifetimes of a number of excited states of these ions. On the basis of the information which was obtained, diagrams were constructed for the energy levels of the ions Er^{3+} and Ho^{3+} in a matrix of $GdAlO_3$. (SJR)

31055 NEW HIGH INTENSITY NANOSECOND ELECTRON SOURCE FOR PULSED RADIOLYSIS. Charbonnier, F. M.; Barbour, J. P.; Brewster, J. L. (Hewlett-Packard Co., McMinnville, OR). pp 3-15 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

Conventional diagnostic techniques for pulse radiolysis in liquids require a useful cell depth of at least 4 mm, hence an electron beam energy of at least 2 MeV. This need for high electron energy has significantly increased the cost, size and shielding requirements of the electron source and has been a deterrent to widespread use of the technique. A new pulsed electron source has been developed which greatly reduces the required electron energy. The source produces two synchronous high intensity beams of 800 keV electrons which irradiate the cell from opposite sides, yielding a highly uniform dose in an aqueous cell with the appropriate thickness of 4 mm. The system and its accessories have been designed to optimize performance and convenience at low cost. The dose delivered by the two beams can be readily varied and monitored over more than three orders of magnitude. Special attention has been given to providing the necessary balance and control of the intensity and penetration of the two beams. Stray radiation and shielding requirements are minimized, and the beam axis can be readily changed from horizontal to vertical position to accommodate various optical designs. The system concept design and measured performance will be discussed. (auth)

31056 GENERATION OF PICOSECOND HIGH INTENSITY BEAM PULSE. Ramler, W.; Mavrogenes, G.; Johnson, K. (Argonne National Lab., IL). pp 25-32 of Fast Processes in Radiation Chemistry and Biology. Adams, G. E.; Fielden, E. M.; Michael, B. D. (Eds.). Chichester, Eng.; John Wiley and Sons Ltd. (1975).

From proceedings of fifth L. H. Gray conference on fast processes in radiation chemistry and biology; Brighton, England (10 Sep 1973).

Argonne's high current electron linac (Gallagher et al. I.E.E.E. Trans. Nucl. Sci.; NS-18:584(1971)) has been operational since September 1969. Good quality beams are produced from 4 to 20 MeV with peak pulse currents ranging from 2A to 10 s to 20A at 10 ns. Recently the installation of a new bunching system was completed enabling the experimentalists to extend their studies to the picosecond time domain. A beam pulse as short at 40 ps in duration with charge of at least 7 nC (180 A amplitude) can now be routinely generated; all other beam characteristics have been conserved. This short pulse has a total energy spread less than or equal to 300 keV. Pulse repetition rate is variable from one single pulse to 800 pulses per second. (auth)

Atomic and Molecular Properties

Refer also to abstracts 28596, 31031, 31054, 31121, 31125, 31130, 31132, 31139, 31145, 31150–31153, 31177, 31185, 31188, 31198, 31930, and 32105.

31057 (INIS-mf-1979, pp 42-68) THE HYPERFINE Λ-DOUBLING SPECTRUM OF $^{14}N^{16}O$ AND $^{15}N^{16}O$. Meerts, W. L.; Dymanus, A. 15 May 1975.

Also published in Journal of Molecular Spectroscopy (USA), v. 44(1972) p. 320-346.

In properties of diatomic open-shell molecules by the molecular-beamelectric-resonance spectroscopy. (Katholieke Universiteit Nijmegen (Netherlands)).

The molecular beam electric resonance method was used for the investigation of the hyper-fine Λ-doubling transitions $\Delta J = 0$, $\Delta F = 0, \pm 1$ for a number of J values of both the $^2\Pi_{\frac{1}{2}}$ states of the moleculed $^{14}N^{16}O$ and $^{15}N^{16}O$. The observed spectrum is explained using the degenerate perturbation theory introduced by Freed. This theory is adapted for a ^2H molecule and includes contributions up to third order in fine and hyperfine structure. The agreement between observed and calculated values is satisfactory.

31058 (INIS-mf-1979, pp 69-72) ACCURATE FREQUENCIES BELOW 5 GHz OF THE LOWER J STATES OF OD. Meerts, W. L.; Dynamus, A. 15 May 1975.

Also published in the Astrophysical Journal (USA), v. 180(1973) p. L93-L95.

In properties of diatomic open-shell molecules by the molecular-beam electric-resonance spectroscopy. (Katholieke Universiteit Nijmegen (Netherlands)).

The hyperfine Λ-doubling transitions of the low-J states of OD were measured using the molecular beam electric-resonance technique. These measurements are used to calculate some other transitions of OD which might also be of interest for radio astrophysics.

31059 (INIS-mf-1979, pp 73-75) ELECTRIC DIPOLE MOMENTS OF OH AND OD BY MOLECULAR BEAM ELECTRIC RESONANCE, CH. 4. Meerts, W. L.; Dymanus, A. 15 May 1975.

Also published in Chemical Physics Letters (Netherlands), v. 23(1) (Nov 1973), p. 45-47.

In properties of diatomic open-shell molecules by the molecular-beam electric-resonance spectroscopy. (Katholieke Universiteit Nijmegen (Netherlands)).

The Stark shifts of hyperfine Λ-doubling transitions originating from the $^2P1_{\frac{1}{2}}$ level of OH and OD are observed. From these shifts we calculated the values of the electric dipole moments: 1.6676 (9)D for OH and 1.65312(14)D for OD.

31060 (INIS-mf-1979, pp 77-78) THE HYPERFINE Λ-DOUBLING SPECTRUM OF SULFUR HYDRIDE IN THE $^2\Pi_{\frac{1}{2}}$ STATE, CH. 5. Meerts, W. L.; Dymanus, A. 15 May 1975.

Also published in The Astrophysical Journal (USA), v. 187 (1974), p. L45-L46.

In properties of diatomic open-shell molecules by the molecular-beam electric-resonance spectroscopy. (Katholieke Universiteit Nijmegen (Netherlands)).

The hyperfine Λ-doubling spectrum of the five lowest rotational states of the $^2\Pi_{\frac{1}{2}}$, v = 0 state is measured using the molecular-beam electric-resonance method. From the Stark splittings of the observed transition the value of the electric dipole moment of SH is determined: $\mu = 0.7580(1)$ D.

31061 (INIS-mf-1979, pp 79-132) A MOLECULAR BEAM ELECTRIC RESONANCE STUDY OF THE HYPERFINE Λ-DOUBLING SPECTRUM OF OH, OD, SH AND SD, CH. 6. Meerts, W. L.; Dymanus, A. 15 May 1975.

Submitted for publication to the Canadian Journal of Physics.

In properties of diatomic open-shell molecules by the molecular-beam electric-resonance spectroscopy. (Katholieke Universiteit Nijmegen (Netherlands)).

The molecular beam electric resonance method was employed to obtain a complete set of hyperfine Λ-doubling transitions of the free radicals OH, OD, SH, and SD. The observed spectra could very well be explained by the degenerate perturbation theory adapted to the $^2P1$ state. The experimental results include fine and hyperfine coupling constants and the electric dipole moments for all four molecules and some magnetic properties of SH. The deduced hyperfine coupling constants agree well with the ab-initio calculations.

31062 (UCRL-Trans-11000) ORTHO-PARA EQUILIBRIUM OF H_2, D_2, AND T_2. Frauenfelder, R.; Heinrich, F.; Olin, J. B. Translated from Helv. Phys. Acta; 38: No. 3, 279-298(1965). 32p. Dep. NTIS $4.00.

The thermodynamic ortho-para-equilibria in the H_2, D_2, and T_2 systems were determined in the temperature range from 20 to 250°K with an accuracy of 0.4, 0.1 and 0.6 percent paraconcentration respectively. In order to produce equilibrium mixtures of gases corresponding to the theory by Dennison, the hydrogen isotopes were adsorbed on CeO_2. After ortho-para-transition had taken place, a small sample of the adsorbed gas was isothermally desorbed and the para content determined through a comparative measurement of thermal conductivity. The thermal conductivity cells were calibrated using a mixture of normal gas and gas which had been equilibriated at 20°K. These cells were operated at liquid nitrogen temperature. They contained thermistors with a large temperature coefficient permitting 0.01 percent relative changes in thermal conductivity to be determined reproducibly. The maximum deviation between measured equilibrium concentrations and those computed according to the theory by Dennison amounted to 1.6 and 0.6 percent para concentration for H_2 and D_2 respectively, but to 6.0 percent for T_2. The ionizing effect of tritium beta-activity is the probable cause for this difference in behavior. Further consequences of the beta-radiation are a p yields o reversion of T_2 in the gas phase at room temperatures (T/sub ½/ approximately 100 min.) and a o yields p conversion in solid T_2 at 4.3°K [T/sub ½/ equals (90 +- 10) min.] (auth)

31063 ALTERNATIVE FORMS OF THE VARIATIONAL PRINCIPLE IMPLYING THE GENERALIZED THOMAS–FERMI THEORY. Bezak, V. (Comenius Univ., Bratislava). Czech. J. Phys.; B26: No. 3, 306-319(1976).

A gas of fermions in a static potential is investigated within the framework of the March–Murray perturbation scheme equivalent to a generalization of the Thomas-Fermi theory. The corresponding variational principle, due to Stoddart and March, is complemented by an alternative form. In contrast with the Stoddart-March formulation whose nature is Hamiltonian and which requires variations of the particle density in the total energy functional formulation, found to be of Lagrangian nature, does variations with respect to the potential function. Both the (alternative) quantum variational (many-body) principles are formulated self-consistently, with due attention to the Poisson equation of electrodynamics. They are considered first for zero temperature and afterwards for arbitrary temperatures. The functional considerations involved are related with thermodynamics of quantum microcontinuum. The functional concepts are clarified by demonstrating them on some simple analogy. Therefore, a variational calculation of the ground state energy of π^- "mesoatoms" or "mesoions" is given. It leads mathematically to the well-known problem of calculating the ground 1 S (para-state) energy of two electrons in the helium atom. (auth)

31064 WIDE ENERGY RANGE APPROXIMATION FORMULA FOR HYDROGEN GAUNT FACTOR. Sapar, A.; Kuusik, I. Publ. Tartu. Astrofiz. Obs.; 42: 272-280(1974).

A relatively simple and exact formula is presented for determination of the Gaunt factors of a hydrogen atom, or for hydrogenic atoms if E is treated in the units of the ionization energy of the corresponding ions. (GHT)

31065 DETAILED QUANTUM TRANSITION STATE THEORY. Light, J.C. (Department of Chemistry and The James Franck Institute, The University of Chicago, Chicago, Illinois 60637); Altenberger-Siczek, A. J. Chem. Phys. 64: No. 5, 1907-1913 (1 Mar 1976).

The detailed quantum transition state theory (DQTST) is presented. It allows quantum effects to be obtained from greatly simplified calculations by applying boundary conditions corresponding to flux in the product direction at the transition state and solving for nonreactive scattering *S*-matrix elements. These are used to obtain the reaction probability from specific initial states. It is compared to the transition state theory (TST) and the complete quantum calculations for the planar $H+H_2$ reaction. The convergence of DQTST to the exact results is shown to be very good. (auth)

31066 DOUBLY CHARGED NEGATIVE ATOMIC IONS OF HYDROGEN. Anbar, M.; Schnitzer, R. (Stanford Research Inst., Menlo Park, CA). Science; 191: No. 4226, 463-464(6 Feb 1976).

The existence of a relatively long-lived doubly charged negative atomic ion H^{2-} (and D^{2-}), isoelectronic with the lithium atom, has been demonstrated by mass spectrometry through a combined analysis of ion energy, velocity, and momentum. This species, formed in a hydrogen plasma, has a half-life of 2.3×10^3 seconds before it spontaneously dissociates to produce H^- ions. (auth)

31067 HARTREE–FOCK WAVE FUNCTIONS AND OSCILLATOR STRENGTHS FOR THE HELIUM ISOELECTRONIC SEQUENCE. Datta, D. K.; Ghoshal, S. K.; Sengupta, S. (Jadavpur Univ., India). J. Quant. Spectrosc. Radiat. Transfer; 16: No. 1, 49-52(1976).

Oscillator strengths for $1^1S - n^1P$ transitions for some members of the helium isoelectronic sequence have been calculated by utilizing the dipole length, velocity and acceleration forms of the transition matrix element with coupled H.F. wave functions. Good agreement has been obtained between the values of the oscillator strengths. The quantities $(f_A - f_L)$ and $(f_A - f_V)$ decrease slowly with nuclear charge Z, whereas $(f_L - f_V)$ first increases to a maximum value and then decreases slowly. (auth)

31068 PHOTOABSORPTION COEFFICIENT OF MOLECULAR OXYGEN IN THE VICINITY OF THE HYDROGEN LYMAN-ALPHA LINE. Dose, V.; Schmocker, U.; Sele, G. (Wuerzburg Univ. (F.R. Germany). Physikalisches Inst.). Z. Phys., A; 274: No. 1, 1-8 (Aug 1975). (In German).

The photoabsorption coefficient of molecular oxygen has been measured at 1,215.70 A and in the ranges 1,205 A–1,214 A and 1,218 A–1,225 A with an average resolution of ±0.015 A. The light source in this experiment was the Doppler shifted radiation obtained from Stark quenching of a metastable hydrogen beam with energies between 2 keV and 60 keV. Using observation angles of 45°, 90°, and 135° with respect to the beam the above mentioned tuning ranges are obtained. Analytical expressions for the absorption coefficient for use in geophysical applications are presented for the whole wavelength range 1,205 A–1,225 A. The rotational structure of the absorption coefficient in the range 1,220 A–1,223 A is clearly resolved in the present measurements. A transition probability of $A = 4 \times 10^4\ s^{-1}$ is obtained for this system. A careful study of a possible pressure dependence of the absorption coefficient was made. Except for the region where rotational line absorption occurs and the single point at 1,215.70 A no measurable effect was found for pressures below 100 Torr. (DE)

31069 FIRST-ORDER PERTURBATION TREATMENT OF THE SHORT-RANGE REPULSION IN A SYSTEM OF MANY CLOSED-SHELL ATOMS OR MOLECULES. Jeziorski, B.; Bulski, M.; Piela, L. (Univ. of Warsaw). Int. J. Quant. Chem.; 10: No. 2, 281-297(Mar 1976).

Assuming a determinantal form for the wave-functions of free molecules, explicit formula for the first-order interaction energy

of many closed-shell molecules was derived. Provided that the determinants describing the free molecules are constructed from the Hartree–Fock orbitals, the two-, three-, and four-body effects predicted by the first-order perturbation theory are closely related to those which one obtains in the framework of the Loewdin LCAO MO-type approach. The results are illustrated by numerical calculations for the system of three ground-state helium atoms. (auth)

31070 SPIN–DENSITY-FUNCTIONAL FORMALISM FOR QUANTUM MECHANICAL CALCULATIONS: TEST ON DIATOMIC MOLECULES WITH AN EFFICIENT NUMERICAL METHOD. Gunnarsson, O.; Johansson, P. (Chalmers Univ. of Tech., Goteborg). Int. J. Quant. Chem.; 10: No. 2, 307-323(Mar 1976).

The spin-density-functional (SDF) formalism with the local-spin-density (LSD) approximation is applied to a number of small molecules with the primary aim of testing the approximation for molecular applications. A new numerical method to solve the one-electron wave equation is developed, utilizing the special features of the SDF formalism. Energy curves, dissociation energies, and equilibrium distances for some diatomic molecules [H_2^+(2SIGMA+/sub g/, 2SIGMA+/sub u/), H_2(1SIGMA+/sub g/, 3SIGMA+/sub u/), He_2^{2+}(1SIGMA+/sub g/), and He_2(1SIGMA+/sub g/)] and the vibrational frequencies of H_2. The deviations from the experimental results are typically ½ eV for the energies and less than or equal to 0.1 A for the distances. The LSD approximation is discussed using the concept of an exchange-correlation hole and predictions about the applicability to other molecules are made. The LSD approximation is compared with the Hartree–Fock and multiple-scattering-X alpha methods, and some difficulties in the latter methods are pointed out. It is argued that the SDF formalism within the LSD approximation has physical advantages compared to the Hartree–Fock and X alpha methods and that it should provide a simple and useful method for a broad range of applications. (auth)

31071 1P AUTOIONIZATION STATES OF He IN THE ELASTIC SCATTERING REGION. Chen, I. H. Raleigh, NC; North Carolina State Univ. (1975). 76p. University Microfilms Order No. 75-17,097.

Thesis (Ph. D.).

Following the method of Feshbach projection operator formalism, 1P autoionization states of He in the n equals 1 to n equals 2 energy region was investigated. Variational functionals are constructed for solving the closed channel components and these results are compared with the absorption spectrum measured by Madden and Codling. In the open channel components the Coulomb wave function is used. Together with closed channel components, we calculate the line width of 1P and 3P resonance states. Comparison of these results with the previous calculation and with experimental data is also discussed. (Diss. Abstr. Int., B)

31072 ANALYSIS OF THE CONFIGURATIONS $5d^86s^2$ IN Pt I THROUGH Hg III AND $5d^96p$ IN Pt I THROUGH Bi VI. Goldsmith, S.; Conway, J. G. (Univ. of California, Berkeley). J. Opt. Soc. Am.; 65: No. 11, 1371-1375(Nov 1975).

The levels of the configurations $5d^86s^2$ in Pt I through Hg III and $5d^96p$ in Pt I through Bi VI were calculated and compared with experiment. The experimental levels of $5d^96p$ in Pt I and $5d^86s^2$ in Au II do not agree with the calculated values. Some minor corrections are suggested for the other ions. The published g factors of Au II are shown to be rather doubtful. (auth)

31073 STARK–ZEEMAN EFFECT OF METASTABLE HYDROGEN MOLECULES. Kagann, R. H. Boulder, CO; Univ. of Colorado (1975). 124p. University Microfilms Order No. 76-3913.

Thesis (Ph. D.).

The Stark effect of the N equals 1 rotational level of orthohydrogen and the N equals 2 rotational level of parahydrogen in the metastable c3PI/sub u/ electronic state has been measured using the molecular beam magnetic resonance method. The Stark effect of the metastable state is 10,000 times larger than that of the ground electronic state. The Stark effect of parahydrogen was found to be weakly dependent on static magnetic field strength, whereas the Stark effect of orthohydrogen was found to be more strongly dependent on the magnetic field strength. The Stark effect of orthohydrogen has been calculated using second-order perturbation theory with a pure Stark effect perturbation. The magnetic field dependence of the Stark effect was calculated using third-order perturbation theory with a mixed Stark–Zeeman effect double perturbation. A comparison of the experimental and theoretical values of alpha/sub perpendicular/ provides information on the electronic transition moment connecting the c3PI/sub u/ state to the a3SIGMA+/sub g/ state. The transition moment is needed to calculate the radiative lifetimes of the various vibrational levels of the c3PI/sub u/ state. The transition moment also enters the calculation of the quenching of this metastable state by an external electric field. There is a disagreement between theoretical predictions and the results of an experiment on the electric field quenching of the metastables. A test of the electronic transition moment may help shed light on this question. The experimental determination of the values of the transition moments allows one to test theory by comparing these values to those obtained by calculations employing ab initio wavefunctions. (Diss. Abstr. Int., B)

31074 1/Z PERTURBATION EXPANSION STUDY OF THE LITHIUM ISOELECTRONIC SEQUENCE. Onello, J. S. Cambridge, MA; Harvard Univ. (1974). 116p. University Microfilms Order No. 76-4475.

Thesis (Ph. D.).

A generalized numerical procedure is provided for calculating atomic properties, based on a 1/Z nuclear charge series expansion. Such a perturbation approach allows a single calculation for a given ionic species to be extended easily to include other members of the isoelectronic sequence. In Chapter I, the eigenvalues and eigenfunctions for the $(1s)^2\ 2s\ ^2S$ and $(1s)^2\ 2p\ ^2P$ states, as well as the oscillator strength for the resonance transition, are calculated for OVI. The 1/Z expansion method is used to extend these calculations to include members of the lithium isoelectronic sequence from BIII to SiXII. Similar computations are done in Chapter II for the $(1s)^2\ 3s\ ^2S$, $(1s)^2\ 3p\ ^2P$ and $(1s)^2\ 3d\ ^2D$ states of the series. The magnetic quadrupole decay rates (M2) for the (1s2s2p) 4P/sub 5.2//sup o/ to $(1s)^2\ 2s\ ^2S$/sub 1.2//sup e/ transition are computed for the sequence from LiI through AXVI. It is explicitly demonstrated that, for high values of nuclear charge, the magnetic quadrupole decay channel becomes comparable to that of autoionization in determining the lifetime of the metastable state. Application of the stabilization method in Chapter IV yields values for the resonance energies of the ^2P 1s (2s2p 1P) and 1s (2s2p 3P) autoionizing states using configuration interaction wave functions. Chapter V treats a preliminary study of the Stieltjes imaging of the lithium photoabsorption profile by a pseudospectrum developed from L^2 basis functions. (Diss. Abstr. Int., B)

31075 AN ALTERNATIVE METHOD OF OBTAINING APPROXIMATE SOLUTIONS TO THE DIRAC EQUATION. 1. Moore, R. A. (Waterloo Univ., Ontario (Canada)). Can. J. Phys.; 53: No. 13, 1240-1246(1 Jun 1975).

An alternative method of obtaining approximate solutions to the Dirac equation is presented. The method takes advantage of the fact that the wave functions can be written as an ordered series in powers of the fine structure constant, α, and that the Hamiltonian can be separated into two parts such that one part connects adjacent orders of the wave function. Energy calculations to order α^2, requiring only the solution to the lowest order equation, are considered in this article. The procedure is tested by applying it to the hydrogen atom. It is seen that the lowest order equations are similar to and no more difficult to solve than the nonrelativistic equations for all systems of physical interest. The simplicity and accuracy of the method implies that full relativistic calculations are unnecessary for most situations. The inclusion of electric and magnetic fields and the solution to the first order equation will be considered in later articles. (auth)

31076 ON THE COMPUTATION OF DIPOLE TRANSITIONS IN THE HD MOLECULE. Wolniewicz, L. (Guelph Univ., Ontario (Canada). Dept. of Physics). Can. J. Phys.; 53: No. 13, 1207-1214(1 Jul 1975).

A method is presented allowing accurate computations of the weak dipole transition moments in HD. As an illustration the method is applied to the calculation of the Σ_u components of the wave functions. The Σ_u contributions to the transition moments are computed and upper bounds for the energy corrections due to Σ_g-Σ_u coupling are given. It is argued that the j dependence of the total transition moment is of the order of 10^{-6}D. (auth)

31077 SEMI-EMPIRICAL STATE EQUATION OF DENSE HELIUM. Gavrilov, S. D. Inzh.-Fiz. Zh.; 27: No. 5, 878-882 (Nov 1974). (In Russian)

For English translation see the journal J. Eng. Phys.

31078 DOUBLE EXCITATION OF HELIUM ATOM IN AN INTENSE LASER BEAM. Nayak, V.; Mohan, M.; Chand, P.; Thareja, R. K. (Univ. of Delhi). Acta Phys. Acad. Sci. Hung.; 38: No. 4, 267-278(1975).

The transition amplitude for the case of double excitation in helium by the absorption of large number of photons of an intense beam is evaluated using the method given by REISS. Correlated BYRON-JOACHAIN wave function is used for the ground state of helium atom. Results show an important nonlinear effect at high intensity. However, at low intensity the behavior is similar to that of perturbation theory results. (auth)

31079 STRUCTURE OF HYPERFINE RESONANCE LINES OF IONS OSCILLATING HARMONICALLY IN AN ELECTRIC FIELD. Major, F. G.; Duchene, J. L. (Centre National de la Recherche Scientifique, 91 - Orsay (France). Lab. de l'Horloge Atomique). J. Phys. (Paris); 36: No. 10, 953-959(Oct 1975). (In French).

The theory is developed for the structure of the microwave hyperfine spectrum observed for ions suspended harmonically in a quadrupole rf field. It is shown that the linear Doppler effect leads to a well resolved system of side bands whose relative amplitudes are sufficient to determine the energy distribution of the ions and hence evaluate the second order Doppler correction for the central line. (FR)

31080 EXCITATION PROCESSES LEADING TO A DIFFERENCE BETWEEN THE EMISSION AND THE ABSORPTION LINE-WIDTHS OF THE HeI LINE. Damaschini, R.; Brochard, J. (Centre National de la Recherche Scientifique, 91 - Orsay (France). Lab. Aime Cotton). J. Phys. (Paris); 36: No. 10, 923-925(Oct 1975). (In French).

In a weakly excited discharge at low pressure, the width observed for the emission line $\lambda = 492.2$ nm in HeI differs from the width observed for the absorption line. The experimental set-up is described and an interpretation is proposed in terms of excitation mechanisms which modify velocity distributions. (FR)

31081 STARK-ZEEMAN EFFECT OF METASTABLE ORTHOHYDROGEN AND PARAHYDROGEN. Kagann, R.H.; English, T.C. (Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80309). Phys. Rev. A 13: No. 4, 1451-1462 (Apr 1976).

The Stark effect of the $N = 1$ rotational level in the metastable $c\,^3\Pi_u$ electronic state of orthohydrogen has been measured using the molecular-beam magnetic-resonance method. The Stark-shift coefficients of orthohydrogen, unlike those of parahydrogen, are strongly dependent on static magnetic field strength. The measured magnetic field dependence of these coefficients agrees with a calculation in which we assume that the major contribution to this phenomenon is the mixing of hyperfine levels by the Zeeman-effect perturbation. The extrapolated zero-magnetic-field values of the Stark-shift coefficients are in reasonable agreement with the corresponding theoretical values. The Stark effect of the $N = 2$ rotational level of parahydrogen has been remeasured with considerable reduction in the experimental uncertainties. This allows a more meaningful comparison with theory. At large magnetic field strengths (100–150 G) the Stark effect of para-H_2 exhibits a small dependence on magnetic field which is due to mixing of the fine-structure levels by the Zeeman-effect perturbation. (auth)

31082 PHOTOABSORPTION FOR HELIUM, LITHIUM, AND BERYLLIUM ATOMS IN THE RANDOM-PHASE APPROXIMATION WITH EXCHANGE. Amusia, M.Ya.; Cherepkov, N.A. (A. F. Ioffe Physical-Technical Institute of the Academy of Sciences of the USSR, Leningrad, USSR); Zivanović, D.; Radojević, V. Phys. Rev. A 13: No. 4, 1466-1474 (Apr 1976).

The photoionization cross sections and the oscillator strengths for helium, lithium, and beryllium atoms are calculated in the framework of the random-phase approximation with exchange. The energy-level shift for discrete transitions is taken into account consistently in this approximation. The results are compared with other many-body calculations and with experimental data. The comparison shows that the random-phase approximation with exchange can even be used for systems with a small number of particles. (auth)

31083 ENERGY AND WIDTH OF *S*-WAVE ELECTRON-HYDROGEN RESONANCES. Chung, K.T. (Department of Physics, North Carolina State University, Raleigh, North Carolina 27607); Chen, J.C.Y. Phys. Rev. A 13: No. 4, 1655-1656 (Apr 1976).

The energies and widths of the *S*-wave resonances of H^- are calculated by using a continuum wave function in which the resonance effect is removed. This method improves our earlier results and brings the existing accurate theoretical results into excellent agreement. (auth)

31084 VIBRATIONAL SPECTROSCOPY OF MATRIX-ISOLATED UF_6 AND UF_5. Paine, R.T. (Department of Chemistry, University of New Mexico, Albuquerque, New Mexico 87131); McDowell, R.S.; Asprey, L.B.; Jones, L.H. J. Chem. Phys. 64: No. 7, 3081-3083 (1 Apr 1976).

The vibrational spectrum of UF_6 molecules isolated in Ar, Xe, and CO matrices is reported. Also, the ir spectrum of monomeric UF_5 molecules produced in these matrices by photolysis with uv radiation is reported. (AIP)

31085 CALCULATION OF ADIABATIC RADIAL AND ANGULAR-MOMENTUM MATRIX ELEMENTS USING VARIATIONAL WAVEFUNCTIONS FOR H_2^+. Schinke, R.; Krüger, H. (Fachbereich Physik, Universität Kaiserslautern, 675 Kaiserslautern, Federal Republic of Germany). J. Chem. Phys. 64: No. 6, 2450-2455 (15 Mar 1976).

Several adiabatic energy curves and wavefunctions for H_2^+ are calculated using a variational treatment. The agreement with exact adiabatic energies is excellent. Further, these variational wavefunctions are used to evaluate the radial matrix elements $\langle\alpha|d/dR|\beta\rangle$ and the angular-momentum matrix elements $\langle\alpha|L_y|\beta\rangle$ which are needed for treating atom–atom collisions by use of expansions in molecular states. (auth)

31086 EXISTENCE OF H^{2-}, A RELATIVELY LONG-LIVED DOUBLY CHARGED NEGATIVE ATOMIC HYDROGEN ION. Schnitzer, R.; Anbar, M. (Mass Spectrometry Research Center, Stanford Research Institute, Menlo Park, California 94025). J. Chem. Phys. 64: No. 6, 2466-2480 (15 Mar 1976).

Doubly charged negative hydrogen ions H^{2-} and D^{2-} have been indirectly observed in a tandem mass spectrometer using a hollow cathode duoplasmatron ion source. The half-life of these doubly charged ions, determined in a number of drift time experiments, is 23 ± 4 nsec. The existence of these ions is concluded from a velocity, momentum, and energy analysis of hydride ions produced in the autodetachment process: $X^{2-} \rightarrow X^- + e$ (X=H,D). (auth)

31087 SPECTROSCOPIC PROPERTIES OF IONS. Richardson, J. H. (Univ. of California, Livermore). Am. Lab.; vp(Nov 1975).

From Pittsburgh conference on analytical chemistry and applied spectroscopy; Cleveland, Ohio (USA) (3 Mar 1975).

Among the spectroscopic properties of ions discussed are photodissociation and photodetachment cross sections. Various new techniques for determining these properties are noted. It is concluded that technological advances have made it feasible to study experimentally the spectroscopic properties of ions. This knowledge will contribute greatly to an understanding of ionic structures, serve as checks for theoretical models, and provide valuable input to the whole field of chemical dynamics. (JFP)

31088 NON-ADIABATIC COUPLING EFFECTS ON THE HIGHLY EXCITED STATES OF HYDROGEN MOLECULE. Patel, M. V. Storrs, CT; Univ. of Connecticut (1975). 139p. University Microfilms Order No. 76-1699.

Thesis (Ph. D.).

Non-adiabatic interaction between two adiabatic excited bound molecular states of H_2* is investigated. This interaction, previously neglected, is used to explain the high molecular population of highly excited (Rydberg) states (n greater than or equal to 10 for the outer electron) of H_2 measured by Barnett et al., in beam experiments. This non-adiabatic interaction, or coupling, arises from the nuclear kinetic energy operator acting on the adiabatic electronic wavefunctions. The interaction terms are the derivative terms of the electronic wavefunctions with respect to internuclear separation R. It is found that the strength of the interaction depends on the ratio of the coupling matrix element parallel H/sub nu r/ parallel to the energy difference epsilon between two nearly degenerate states. parallel H/sub nu r/ parallel is found to be of the order of 10^{-6}. Therefore the interaction effect is significant only for very nearly degenerate states. It appears as a result of this investigation, that non-adiabatic coupling between adiabatic excited molecular states explains, partly at least, the high molecular population of H_2* in high Rydberg states measured in the beam experiments. (Diss. Abstr. Int., B)

31089 SPECTRAL EFFECTS IN ATOMIC ABSORPTION SPECTROMETRY. Panday, V. K.; Ganguly, A. K. (Bhabha Atomic Research Center, Bombay). Spectrosc. Lett.; 9: No. 2, 73-80(1976).

Some spectral effects in atomic absorption spectrometry are reported for magnesium–terbium and osmium–chromium interference. (JFP)

31090 ANALYSIS OF THE SPACE CORRELATION FACTORS IN A MCSCF REPRESENTATION OF LiH AND Li_2 MOLECULES. Besson, M. A.; Suard, M. (Laboratoire de Chemie, ENSJF 1, Montrouge, France). Int. J. Quant. Chem.; 10: No. 1, 151-162 (Jan 1976).

The space correlation factor is studied in LiH and Li_2 molecules, using MCSCF wave-functions. The shape of the Fermi hole is related to the localization of molecular space orbitals, while the Coulomb hole study indicates the importance of symmetry properties of the molecular orbitals involved in excited configurations for the representation of the electronic correlation inside the chemical bond. (auth)

31091 DETERMINATION OF THE LINEWIDTH DEPENDENCE ON FOREIGN-GAS PRESSURE FOR 3.4-mu m DF SPECTRA. Bonczyk, P. A. (United Technologies Research Center, East Hartford, CT). Phys. Rev., A; 13: No. 1, 251-252(Jan 1976).

Measurement of v equals 1-0, P-branch 3.4-mu m DF spectra is made for DF mixed with foreign gases at a temperature of 23-25°C. A cw DF laser is used as a light source, and laser intensity trans-

mitted by the gas mixture is measured in order to determine the absorption. From the measured absorption, the ratio of cross sections Q/sub AB//Q/sub AA/ is determined, where Q/sub AB/ is the cross section for collision of DF (equalsA) with a foreign gas (equals B) and Q/sub AA/ is for DF self-collisions. Results are obtained for the single line v equals 1-0, P(8) in the case of D_2, He, N_2, CF_4, and SF_6 and for the lines v equals 1-0, P(5-10) in the case of HF.

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 30266, 31063, 31844, and 32016.

31092 (IPNO-TH-CF-5) MUONIC ATOMS. Campi, X. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). 1975. 20p. (In French). INIS.

From congress of the French Physical Society; Dijon, France (30 Jun 1975).

Different methods of obtaining information about nuclear charge distributions from muonic atom measurements are discussed. The nuclear polarization correction is also considered and a calculation based on the Hartree-Fock approximation is reviewed. (FR)

31093 VALUES FOR THE ELECTRON SCREENING IN MUONIC ATOMS FOR ALL Z. Fricke, B. (Gesamthochschule Kassel (F. R. Germany)); Telegdi, V. L. (Chicago Univ., Ill. (USA)). Z. Naturforsch., a; 30: No. 10, 1328-1329(Oct 1975).

The electron screening correction in the X-ray transitions in muonic atoms is calculated within a relativistic SCF Hartree-Fock procedure for many transitions and all Z. (DE)

31094 ATOMIC STRUCTURE EFFECTS IN NEGATIVE MESON CAPTURE. Kunselman, R. (University of Wyoming, Laramie, Wyoming 82071); Law, J.; Leon, M.; Miller, J. Phys. Rev. Lett. 36: No. 8, 446-448 (23 Feb 1976).

Correlations are noted in the variation with atomic number of kaonic, pionic, and muonic x-ray yields, and positron-annihilation lifetimes in annealed metals. These variations are believed to be due to the variation with Z of the electron density in the outer part of the target atoms. (auth)

31095 PRECISION MEASUREMENT OF THE DECAY RATE OF ORTHOPOSITRONIUM IN SiO_2 POWDERS. Gidley, D.W.; Marko, K.A.; Rich, A. (Department of Physics, University of Michigan, Ann Arbor, Michigan 48109). Phys. Rev. Lett. 36: No. 8, 395-398 (23 Feb 1976).

The decay rate of orthopositronium is found to depend linearly on the mass per free volume in powders of SiO_2 with grain radii of 35 and 70 A. Three data points have a decay rate significantly less than both the theoretical free-space decay rate and the results of previous experiments. The value of λ_3 extrapolated to zero density, 7.104 ± 0.006 μsec^{-1}, is (1.9 ± 0.1) % below the theoretical value of the free-space lifetime. Possible interpretations of these results are discussed. (auth)

31096 ABSORPTION OF POSITRONS IN ALUMINUM. Vorob'ev, S. A.; Kuz'minykh, V. A.; Tsekhanovskii, I. A. Prikl. Yad. Spektrosk.; No. 5, 3-5(1975). (In Russian)

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The absorption curves of positrons with initial energies of 230, 307, and 384 keV were measured for Al absorbers. The experimental curves obtained show the dependence of the number of absorbed positrons as centers of two-photon annihilation on the thickness of the Al target. The experimental results are compared with good agreement with the results calculated on the basis of the mean free path model. (JSR)

31097 HIGHER ORDER RADIATIVE CORRECTIONS IN MUONIC ATOMS. Borie, E. (Swiss Inst. for Nuclear Research, Villigen). Helv. Phys. Acta; 48: 671-674(1975).

Radiative corrections of order $\alpha^2(Z\alpha)$ corresponding to the fourth order Lamb shift for muonic atoms are calculated. Numerical results are presented for the 1s, 2s, and 2p states of Nd and Hg. All contributions other than the well-known contribution due to fourth order electron vacuum polarization are too small to be experimentally important. (auth)

31098 ELECTRIC FIELD AND TEMPERATURE DEPENDENCE OF POSITRON ANNIHILATION IN ARGON GAS. Lee, G. F. Vancouver; British Columbia Univ. (1972). 124p. INIS.

Thesis.

The annihilation rate of positrons in argon was measured over the temperature range of 135 K to 573 K with applied d.c. electric fields up to 35 V cm^{-1} $amagat^{-1}$. Analysis of this date was carried out assuming that the annihilation rate and the momentum-transfer rate can be approximated by a function of the form Av^B over this velocity range. Results of this analysis indicate a strong velocity dependence in both the annihilation rate and the momentum-transfer rate. For velocities in atomic units ($e^2/\hbar$) corresponding to positron wave number from .03 to .065 a_0^{-1} the annihilation rate was found to be adequately represented by $\nu_a(v) = (1.195 \times 10^6)v^{-.480}$ sec^{-1} $amagat^{-1}$. The momentum-transfer rate was similarly determined as $\nu_d(v) = (2.11 \times 10^{11})v^{-.49}$ sec^{-1} $amagat^{-1}$. The errors in these results are velocity dependent. The largest error is 16%. This velocity dependence at low energies is not reproduced satisfactorily by any current theoretical models. A modified effective range parameterization of the momentum-transfer cross section gives a scattering length of $A_0 = -4.4 \pm .5$ a_0 for positron-argon collisions. No evidence of a velocity dependence in the orthopositronium quenching rate at room temperature was detected. The orthopositronium quenching rate was measured at $.255 \pm .009$ μ sec^{-1} $amagat^{-1}$, in good agreement with previous results. (auth)

31099 POSITRON ANNIHILATION IN SINGLE CRYSTALS OF COPPER, ZINC, AND MAGNESIUM. Senicki, E. M. D. Winnipeg; Manitoba Univ. (1972). 107p. INIS.

Thesis.

A point geometry angular correlation apparatus for the study of positron annihilation in metals was constructed. The apparatus achieves a high coincidence counting rate and is applicable to the study of all metals and alloys. Angular distributions of the annihilation radiation from annealed single crystals of copper, zinc, and magnesium have been measured. The results are compared with the predictions obtained using a Wigner-Seitz type of calculation for the positron wavefunction and a more realistic calculation which takes the crystal symmetry of the wavefunction into account. The agreement between theory and experiment is considerably improved in the case of magnesium by the use of an enhancement factor.

31100 POLYELECTRON WHEELER SYSTEMS IN DEFECT CRYSTALS. Arefev, K.P.; Prokopev, E.P. Opt. Spectrosc. (USSR) 39: No. 5, 572-573 (Nov 1975).

The annihilation of positrons in alkali halide crystals is studied. The mechanism of formation of Wheeler compounds with F−centers in the crystals, and subsequent trapping of positrons by the F−centers is reported.(AIP)

31101 POSITRON-HYDROGEN SCATTERING USING AN INTEGRAL APPROACH. Basu, D.; Banerji, G.; Ghosh, A.S. (Indian Association for the Cultivation of Science, Calcutta 700032, India). Phys. Rev. A 13: No. 4, 1381-1387 (Apr 1976).

The positron-hydrogen collision problem has been investigated using an integral form of the close-coupling approximation for a wider range of energies. The present formalism takes care of the rearrangement channel. The effects of the excited states of both the hydrogen and positronium atoms have been neglected. The elastic and the positronium-formation cross sections have been obtained explicitly in the energy region 0–200 eV. Because the integral form was used, the two-state results are reliable. The present results differ from the first Born results even at 200 eV. (auth)

31102 FORMATION OF MESONIC ATOMS IN CONDENSED MATTER. Daniel, H. (Technical Univ., Munich). Phys. Rev. Lett.; 35: No. 24, 1649-1651(15 Dec 1975).

The formation of mesonic atoms in condensed matter is calculated with a parameter-free classical model. The probability for Coulomb capture is found to be proportional to Z/sup 1/3/ ln(0.57Z). It is shown by a chi^2 test performed for metal halides that the new formula reproduces well the experimental data. (auth)

31103 ANNIHILATION LIFETIMES OF POSITRONS BOUND IN POSITRONIUM COMPLEXES. Madia, W. J.; Ache, H. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). J. Phys. Chem.; 80: No. 5, 451-453(26 Feb 1976).

An experimental approach is described to determine the annihilation lifetimes, tau/sub c/, of positrons in Ps complexes of p-dinitrobenzene and p-benzoquinone in organic solvents. It is based on the dependence of I_2, the intensity of the long-lived component in the positron lifetime spectra, on the chemical reaction rates of the Ps atoms with the substrate molecules, which in turn vary as a function of temperature. From the experiments an average value for tau/sub c/ equals 0.36 +- 0.10 ns has been obtained. (auth)

31104 FORMATION OF POSITRONIUM IN POLYCRYSTALLINE AND GLASSY POLAR SUBSTANCES. Anisimov, O. A.; Molin, Yu. N. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 4, 331-332(1975).

Translated from Khim. Vys. Energ.; 9: No. 4, 376-377(1975).

According to a previously proposed model, the formation of positronium in condensed media occurs in the track of a positron by its reaction with electrons. The experimental test described here confirmed the suggestion that a significant increase in I_2, the intensity of the long lived component of the time dependent spectrum of its annihilation, might be expected on crystallization of polar liquids, but not on glassification. I_2 was measured at various temperatures in the liquid and solid phases of water, methanol, tert-butanol, n-heptanol, ethanol, n-propanol, iso-propanol, and n-butanol. The solid structure, radiation yield, I_2, and the lifetime of the triplet positronium was tabulated for the experimental systems. (DDA)

Collision Phenomena

Refer also to abstracts 28436, 28965, 31034, 31040, 31101, and 31205.

31105 (AD/A-007065) ELECTRONIC COLLISION CROSS SECTIONS AND IONIZATION PHENOMENA IN ATMOSPHERIC GASES. Final Report, 1972–1974. Lassettre, E. N. (Mellon Inst. of Science, Pittsburgh, Pa. (USA)). 28 Feb 1975. 32p. NTIS $3.75.

The report gives brief descriptions of generalized oscillator strength determinations on He, Ha, H_2O. The results are also given for theoretical studies on a newly defined transition potential, whose Fourier transform is proportional to the collision amplitude. Theoretical explanations are given for the exceptional strength of excitation of both singlet–singlet and singlet–triplet transitions, by electron impact, in forward scattering when the orbital term symbols are the same in ground and excited states. The first applications of a newly developed electron spectrometer are briefly described. The instrument has been used in both conventional collision cross section studies on the 1 singlet S to 2 singlet S and to 2 singlet P transitions in helium and also, by use of fast coincidence techniques, in the study of the autoionized transition in helium at about 60 eV. (GRA)

31106 (CEA-CONF-3197) VELOCITY DEPENDENCE OF THE PENNING AND ASSOCIATIVE IONIZATION CROSS SECTIONS OF Ar ATOMS BY He(2^3S) AND He(2^1S) ATOMS. Pesnelle, A.; Watel, G.; Manus, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Services de Physique Generale). 1975. 2p. INIS.

From 9th international conference on the physics of electronic and atomic collisions; Seattle, USA (24 Jul 1975).

The velocity dependence of both the Penning and associative ionization cross section of Ar atoms by He(2^3S) and He(2^1S) metastable atoms and of their sum is measured in the velocity range 1200–4500m/sec (30–400 MeV) in a crossed-beam experiment by a time-of-flight technique. Characteristic cross-section ratios associative/total and singlet/triplet are reported along with the relative magnitude of the associative, Penning and total cross sections. The measurements clearly show a difference in the reaction mechanisms involving He(2^3S) and He(2^1S). This difference appears not only in the ratio associative/total, whose magnitude reaches 19% and 38% for He(2^3S) and He(2^1S) respectively at the velocity v = 1200 m/sec (30 MeV), and in the ratio singlet/triplet, which increases from 0.5 to 3.8 for velocity decreasing from 4500 m/sec to 1200 m/sec, but also in the different shapes of the associative and Penning cross sections for He(2^3S) and He(2^1S). (FR)

31107 (CEA-CONF-3198) VELOCITY DEPENDENCE OF THE PENNING IONIZATION OF D ATOMS BY He(2^1S) AND H_2(2^3S) ATOMS. Fort, J.; Laucagne, J. J.; Pesnelle, A.; Watel, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Services de Physique Generale). 1975. 2p. INIS.

From 9th international conference on the physics of electronic and atomic collisions; Seattle, USA (24 Jul 1975).

A time-of-flight technique has been developed for the study of the velocity dependence of the cross section for Penning ionization of D atoms by metastable He atoms: $He(2^1S) + D \rightarrow He(1^1S) + D^+ + e^-$, $He(2^3S) + D \rightarrow He(1^1S) + D^+e^-$. (FR)

31108 (CEA-CONF-3199) THEORETICAL CHARGE EXCHANGE TOTAL CROSS SECTION FOR $B^{+3} + He \rightarrow B^{+2} + He^+$. Olson, R. E.; Shipsey, E. J.; Browne, J. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Services de Physique Generale). 1975. 2p. INIS.

From 9th international conference on the physics of electronic and atomic collisions; Seattle, USA (24 Jul 1975).

Theoretical charge exchange total cross sections have been calculated in the energy range from 150 eV to 15 keV for the reaction $B^{+3} + He \rightarrow B^{+2} + He^+$. The calculations are compared to the experimental results of Zwalley and Cable. (FR)

31109 (CEA-CONF-3200) DESTRUCTION OF METASTABLE HYDROGEN ATOMS IN COLLISIONS WITH He, Ar AND H_2. Rousel, F.; Olson, R. E.; Pradel, P.; Schlachter, A. S.; Spiess, G.; Dose, V.; Hett, W. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Services de Physique Generale). 1975. 2p. INIS.

From 9th international conference on the physics of electronic and atomic collisions; Seattle, USA (24 Jul 1975).

The results of two independent experiments and a theoretical calculation for the total collisional quenching cross section for H(2s) and D(2s) incident on He, Ar, and H_2 targets are reported. One experiment (Wurzburg) was performed at low collision energies (from 0.1 eV to 5 eV), while the other experiment (Saclay) was conducted at higher collision energies (from 60 eV to 3 keV). Since the measured cross sections covered such a wide energy range, it was possible to use the experimental data to find the difference in the interaction potentials between the H(2s) + X and H(2p) + X systems, where X is the target gas. (FR)

31110 (CEA-CONF-3202) EXCITATION TRANSFER CROSS SECTIONS BETWEEN STATES OF ALKALI ATOMS INDUCED BY COLLISION WITH RARE GAS ATOMS. Pascale, J.; Stone, P. M. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Services de Physique Generale). 1975. 2p. INIS.

From 9th international conference on the physics of electronic and atomic collisions; Seattle, USA (24 Jul 1975).

Rigorous calculations of excitation transfer cross sections using a semi-classical method are presented. Recent analysis of such calculations has demonstrated the validity of the semi-classical approach. (FR)

31111 (COO-2718-4) OBSERVATION OF LUMINESCENT SPECTRA IN LOW ENERGY ION-NEUTRAL COLLISIONS. Progress Report for Period June 1, 1975–May 31, 1976. Leventhal, J. J. (Missouri Univ., St. Louis (USA)). Feb 1976. E(11-1)-2718. 19p. Dep. NTIS $3.50.

The experimental investigations reported were directed toward obtaining information on the energy partitioning among internal energy states of the product species resulting from collisions between positive ions and neutral molecules at relative kinetic energies below about 500 eV. Two types of inelastic collision processes have been studied: electron exchange and atomic rearrangement. The data, which were obtained by direct observation of emission spectra resulting from the decay of excited collision products, have been used for product identification and for the determination of state distributions and absolute excitation cross sections. The state distributions have been compared to those predicted from theoretical models, and have also been used to elucidate reaction dynamics. The nature of the potential energy curves (and surfaces) for the species involved has been shown to play an important role in determining energetics and excitation cross sections. One class of dissociative charge transfer (electron exchange) process has been found to be an efficient mechanism for creating a population inversion in a discharge laser cavity. The state distributions and excitation cross sections obtained in this work have provided microscopic details of the collisions that occur in the complex environment of a discharge laser cavity. (auth)

31112 (INIS-mf-1894, pp 71-101) OXYGEN-DEPENDENT PHOTON EMISSION FROM Ne^+-BOMBARDED Mg. Chapter 4. Kerkdijk, C. B. W.; Kelly, R. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam). 28 May 1975.

Chapters 1 and 2 have been published in Atomindex under 186143 and 186121; 43 refs., 11 figs., 2 tables.

In bombardment-induced photon emission from solids. (Rijksuniversiteit Leiden (Netherlands)).

The optical spectrum observed when solid Mg is bombarded with 10 keV Ne^+ consists dominantly of spectral lines from Mg and Mg^+, together with weaker lines from Ne, Ne^+, O^+ and H. Molecular emission, attributed to de-excitation of MgO and MgH is also observed, though with much lower intensity. Some spectral lines are enhanced by oxygen at or in the surface, others are unaffected by oxygen, while some decrease in intensity due to oxygen. Out of 21 lines for which information is available, 16 are shown to have an oxygen dependence which can be understood qualitatively in terms of a model of resonant electron transfer combined with oxygen-induced changes in the band structure. The topography of the – visibly changed – surface of the Mg-target after several hours of bombardment is investigated with a scanning electron microscope.

31113 (INIS-mf-1896, pp 15-79) ABSOLUTE DIFFERENTIAL CROSS SECTIONS FOR ELASTIC SCATTERING OF ELECTRONS BY HELIUM, NEON, ARGON AND MOLECULAR NITROGEN. Chapter 2. Jansen, R. H. J.; de Herrer, F. J.; Luyken, H. J.; van Wingerden, B. 7 May 1975.

This chapter will be published in Journal of Physics B (UK); 83 refs., 12 figs., 16 tables.

In elastic scattering of electrons by noble gas atoms and nitrogen molecules. (Amsterdam Univ. (Netherlands)).

This is a description of an improved electron spectrometer of the Kuyatt-Simpson type. It is an extension of a report by the same authors (FOM nr. 35693, 1974) measuring the absolute differential cross section for N_2 at 500 eV and at scattering angles between 5 and 9°; and relative cross sections of He, Ne, Ar and N_2 at 100 to 3000 eV and scattering angles between 5 and 55°. Improved energy dependence measurements used in the normalization procedure made it possible to obtain a consistent set of absolute cross sections independent of any other experiment or theory. An extensive comparison with experimental and theoretical data from literature is given. Analysis of the exponential behavior of the differential cross section as a function of momentum transfer yielded apparent polarizabilities of the target. Total scattering cross sections were derived from the gas pressure dependence of the scattered signal. (auth)

31114 (INIS-mf-1896, pp 81-112) ABSOLUTE DIFFERENTIAL CROSS SECTIONS FOR ELASTIC SCATTERING OF ELECTRONS BY KRYPTON AND NEON. Chapter 3. Jansen, R. H. J.; de Heer, F. J. 7 May 1975.

This chapter will be published in Journal of Physics B (UK); 25 refs., 9 figs., 8 tables.

In elastic scattering of electrons by noble gas atoms and nitrogen molecules. (Amsterdam Univ. (Netherlands)).

Relative differential cross sections for electrons inelastically scattered by Kr and Xe at impact energies between 100 and 3000 eV and at scattering angles between 5 and 55° are measured. The relative cross sections are put on an absolute scale by using the apparatus calibration factor derived from the authors' absolute measurement on N_2. An extensive comparison with experimental and theoretical data from literature is given. It was possible to derive apparent polarizabilities and total cross sections from the measured data.

31115 (INIS-mf-1896, pp 114-157) THEORETICAL CONSIDERATIONS. Chapter 5. van Wingerden, B.; de Heer, F. J.; Jansen, R. H. J.; Los, J. 7 May 1975.

This chapter will be published in Journal of Physics B (UK); 14 refs., 7 figs., 4 tables.

In elastic scattering of electrons by noble gas atoms and nitrogen molecules. (Amsterdam Univ. (Netherlands)).

The difference in behavior of the differential elastic cross sections observed for He on the one hand, and noble gases on the other, is explained by applying classical and quantum mechanical criteria. Using a classical scaling law we have calculated the distances of closest approach for Ne, Ar, Kr and Xe. For high impact energies we have calculated the differential elastic cross sections for He in the Born and Born-exchange approximation. Comparison is made with the eikonal-Born series, the Rutherford formula and experiment. Finally, a survey of some recent theoretical models in the field of elastic electron-atom scattering is given.

31116 (LBL-4312) K VACANCY PRODUCTION IN MEDIUM-Z HEAVY ION COLLISIONS. Anholt, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-ENG-48. 132p. Dep. NTIS $6.00.

Thesis.

During slow encounters between projectile and target atoms, the electronic atomic wave functions of the two collision partners distort and form molecular orbitals (MOs). K vacancy formation in slow heavy-ion collisions, which occur when electrons are excited out of the 2p sigma and 1s sigma MOs, is considered. Experimental work using 200 MeV Kr ions is described. The main interest is the excitation of electrons from the 1s sigma MO. The 1s sigma vacancy production is only observed in very asymmetric collisions: as Kr K x rays in encounters with target atoms between H and Ar, and as target K x rays in encounters with atoms between Ce and U. Theoretical approximate calculations of 1s sigma ionization cross sections are described. (JFP)

31117 (PUC-TN-19/74) HYDROGEN ATOMS IN STRONG MAGNETIC FIELDS. Brandi, H. S. (Pontificia Universidade Catolica do Rio de Janeiro (Brazil). Instituto de Fisica). Dec 1974. 18p. INIS.

A variational scheme to calculate the energy eigenvalues and eigenfunctions of the hydrogen atom in the presence of a strong magnetic field is proposed. Numerical calculations were performed for several of the lowest states, and for the wavelengths of some allowed transitions. The equivalence of the problems related with solid state physics and astrophysics is briefly discussed and our results compared with previous calculations. Because the suggested scheme converges very fast for fields up to approximately 109G this is a convenient manner to treat problems, where the interest is concentrated in the range of variation of the magnetic field from zero up to approximately 109G. (auth)

31118 ON THE ELECTRON BEAM SCATTERING BY THE MATERIAL UNDER ELECTRON BEAM MACHINING. Boriskina, L. V.; Kabanov, A. N.; Yudaev, V. N. Fiz. Khim. Obrab. Mater.; No. 5, 20-26(1974). (In Russian)

A simple method is described for calculating the field of activation of an electron beam on the substrate in electron-beam processing. Movement of the beam in the medium is described by equations which make possible considering the change in the number of particles in the beam, a decrease in their energy, and an increase in the average beam dispersion angle. The relations obtained can be used to calculate and construct the area of activation of different substances by beams of monoenergetic electrons with different initial energies. (tr-auth)

31119 INTERFERENCES OF MOLECULAR X-RAYS IN HEAVY ION COLLISIONS. Gross, M.; Greiner, W. (Frankfurt Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Phys., A; 274: No. 2, 165-171(1975).

The possibility of coherence effects in molecular orbital X-rays emitted during multiple heavy ion collisions in a crystal target is investigated. That X-ray energy region is found, where in spite of the thermal vibrations of the target atoms interferences have to be expected. The dynamical theory for the molecular orbital evolution is used. The 70 MeV Ni-Ni collisions are treated as an example. An experiment for checking the coherent photon emission in multiple molecular scattering processes is suggested, which in turn can eventually be used to measure the ratio of e.g. triple to binary collision. (DE)

31120 PENETRATION AND SCREENING EFFECTS IN ELECTRON BREMSSTRAHLUNG ON IONS. Gervids, V.I.; Kogan, V.I. (I. V. Kurchatov Atomic Energy Institute). JETP Lett. 22: No. 5, 142-144 (5 Sept 1975).

A semiclassical theory of electron bremsstrahlung in an arbitrary central field is developed. In the case of radiation from a "hard" multielectron ion, the theory yields approximate expressions for the total effective emission and for the spectrum. These expressions demonstrate the transition from radiation from a "pointlike" ion to radiation from a bare nucleus. (auth)

31121 THERMAL DAMPING CONSTANTS AND THEIR CONSTITUENTS FOR HYDROGEN. Sapar, A.; Kuusik, I.; Einasto, L. Publ. Tartu. Astrofiz. Obs.; 42: 223-271(1974).

Results are given for the investigation of inelastic and superelastic, i.e., of nonisoenergetic transition rates, caused by thermal electron collisions and photon impacts, both of them giving the thermal excitation, de-excitation and ionization rates as the constituents of the damping constant, computed values of which are given in tables and plotted in figures. The role of these constituents for different physical conditions is estimated. 28 figures, 7 tables, 10 refs. (GHT)

31122 ENERGY AND ANGULAR CHARACTERISTICS OF ELECTRON AND BREMSSTRAHLUNG RADIATION EMITTED BY FLAT ABSORBERS IRRADIATED BY A BEAM OF MONOENERGETIC ELECTRONS. Baranov, V. F.; Pletnev, V. V.; Smirnov, V. V. Prikl. Yad. Spektrosk.; No. 5, 11-18(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The basic singularity of the model developed of the process of the passage of electrons is in the representation of their trajectory as a series of sequential states, each of which is the result of the passage of an electron through a small plane-parallel layer. The thickness of the layer depends on the electron energy and the atomic number of the medium. Calculated values for the mean energy of the scattering of the electrons are tabulated for C, Al, Cu, Cd, and Pb. Bremsstrahlung energy distribution curves are given for Al and W–Au two-layered targets. The results obtained with the model and with consideration of the generation of bremsstrahlung are sufficiently satisfactory for it to be used in practical problems on the passage of electrons and bremsstrahlung through matter. (JSR)

31123 ENERGY DEPENDENCE OF THE CROSS SECTION FOR ELECTRON-ATOM COLLISIONS IN THE FIRST BORN APPROXIMATION. Baranov, V. F.; Pletnev, V. V. Prikl. Yad. Spektrosk.; No. 5, 19-23(1975). (In Russian)

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

It is proven theoretically that the use of the energy dependence of electron-atom collision cross sections makes it possible to utilize effectively experimental data to obtain necessary data in applied calculations. (JSR)

31124 SOME ASYMPTOTIC PROBLEMS OF THE ELECTRON TRANSPORT THEORY. Kuzyuk, V. A.; Rakhmatulina A. Kh. Zh. Vychisl. Mat. i Mat. Fiz.; 15: No. 5, 1248-1261 (1975). (In Russian).

The form of the doubly differential scattering cross section for electrons on atoms was analyzed. A small parameter, proportional to the ionization energy of the atom measured in mc^2 units, was factored out. It was shown that the solution of the continuously slowing down model poorly approximates the solution of the precise equation. By a correction method an approximate equation was obtained which performed with precision up to second order terms of the triviality. (tr-auth)

31125 ORIENTATION OF HYDROGENIC LEVELS BY STARK EFFECT AND *sp* COHERENCE RESULTING FROM DIRECT EXCITATION OR MOLECULAR DISSOCIATION. Lombardi, M.; Giroud, M. (Laboratoire de Spectrométrie Physique, Université Scientifique et Médicale de Grenoble, 38041 Grenoble Cedex, France). Phys. Rev. Lett. 36: No. 8, 409-412 (23 Feb 1976).

We have measured the predicted orientation induced by first-order Stark effect on *sp* coherent levels of He^+ and H excited by a 100-keV Na^+ beam impinging on a cell filled with He or H_2. We discuss the mechanism of production of *sp* coherence by dissociative excitation of H_2. (auth)

31126 INELASTIC COLLISION INDUCED BY INTENSE OPTICAL RADIATION. Lidow, D.B.; Falcone, R.W.; Young, J.F.; Harris, S.E. (Microwave Laboratory, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 36: No. 9, 462-464 (1 Mar 1976).

A large cross section for inelastic collision is induced by an incident laser tuned to the frequency of the interatomic energy defect. We study energy transfer from the Sr $5p\,{}^1P$ level to the Ca $4d\,{}^1D$ level and measure a cross section for inelastic collision of 3×10^{-16} cm^2 at a laser power density of 8.6×10^6 W/cm^2 and a wavelength of 6409.0 Å. (auth)

31127 PHOTOEMISSION FROM SOME METALS AND SEMICONDUCTORS IN THE ENERGY RANGE 5–350 eV. Lindau, I.; Pianetta, P.; Yu, K.Y.; Spicer, W.E. (Stanford Electronics Laboratories, Stanford University, Stanford, California 94305). J. Vac. Sci. Technol. 13: No. 1, 269-272 (Jan 1976).

During the last year we have used synchrotron radiation from the Stanford Synchrotron Radiation Project (SSRP) to perform uv and soft x-ray photoemission studies of metals and semiconductors in the energy range 5–350 eV. Here, we report on some of the results for Au, Cu, W, and GaAs. An interesting observation for Au is the modulation of the valence-band spectrum for photon energies of 100–200 eV. Furthermore, we illustrate (for the Au 4*f* levels) the feasibility of doing detailed studies on the energy dependence of the photoionization cross sections with a tunable light source. The relative cross section for the Cu 3*p* and 3*d* electrons is drastically different for excitation energies of 200 and 1500 eV, respectively. The distribution curves of the valence band of a tungsten surface covered with an ordered layer of graphite show strong energy and angular dependence. The oxidation properties of GaAs(110) surfaces have been studied by observing chemical shifts of the Ga and As 3*d* levels. It appears that oxygen forms bonds with As, and not Ga, surface atoms during the first stage in the chemisorption. (auth)

31128 ELASTIC SCATTERING MEASUREMENTS OF THE Ar_2^* ($^3\Sigma^+_u$) WELL DEPTH. Gillen, K.T.; Saxon, R.P.; Lorents, D.C.; Ice, G.E.; Olson, R.E. (Molecular Physics Center, Stanford Research Institute, Menlo Park, California 94025). J. Chem. Phys. 64: No. 5, 1925-1929 (1 Mar 1976).

Angular distribution measurements of the scattering of $Ar(^3P_2)$ from $Ar(^1S_0)$ at center of mass collision energies from 5 to 10 eV yield a prominent rainbow maximum at $\tau = E\theta = 81 \pm 3$ eV-deg. Combined with recent high energy ground state scattering data and information derived from the Ar_2^* emission continua, the result implies that $D_e = 0.78 \pm 0.04$ eV and $R_e = 2.33 \pm 0.02$ Å in an assumed Morse form for the lowest 1_u, $0^-_u(^3\Sigma^+_u)Ar_2^*$ excimer potential. (auth)

31129 SCATTERING OF HIGH-VELOCITY He AND Ar BEAMS BY METHANE, SILANE, AND GERMANE. Amdur, I.; Engler, M.J.; Paulsen, D.E.; Jordan, J.E. (Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Mason, E.A. J. Chem. Phys. 64: No. 5, 2048-2050 (1 Mar 1976).

Fast He and Ar beams have been scattered by room-temperature CH_4, SiH_4, and GeH_4 to obtain average atom–molecule potentials for He–CH_4, He–SiH_4, He–GeH_4, Ar–CH_4, and Ar–GeH_4. Somewhat unexpectedly, the potential for He–GeH_4 was intermediate between He–CH_4 and He–SiH_4; this apparent discrepancy, however, correlates with the bond polarities. The potential for Ar–CH_4 can be satisfactorily predicted from that for He–CH_4 by means of simple potential models and combination rules. The analogous prediction for Ar–GeH_4 is unsatisfactory; reasons for the discrepancy are discussed. (auth)

31130 CROSSED-BEAM STUDY OF THE REACTION $H_3^+(D_2,H_2)D_2H^+$. Vestal, M.L.; Blakley, C.R.; Ryan, P.W.; Futrell, J.H. (Department of Chemistry, University of Utah, Salt Lake City, Utah 84112). J. Chem. Phys. 64: No. 5, 2094-2111 (1 Mar 1976).

A new crossed-beam apparatus has been applied to a study of the dynamics of simple proton and deuteron transfer reactions [M. L. Vestal, Ph. D. Dissertation, University of Utah, Salt Lake City, Utah (1975)]. The results of detailed studies of the reactions $H^+_3(D_2,H_2)D_2H^+$ and $D^+_3(H_2D_2)H_2D^+$ are presented. Results are also reported on the reactions $H^+_3(Ar,H_2)ArH^+$ and $H^+_3(N_2,H_2)N_2H^+$. The experimental results are presented as contour maps of relative intensity normalized for Cartesian velocity coordinates plotted superimposed on the Newton diagram as described by Cross and Wolfgang [J. Phys. Chem. 73, 743 (1969)]. The data are also presented in an intensity contour plot using the relative translational energy and center-of-mass scattering angle as rectangular coordinates. This method for plotting data from crossed-beam experiments, which was developed in this work, has the advantage that the relative differential cross sections as functions of relative translational energy of the products and center-of-mass scattering angle are directly displayed. Product angular distributions obtained by integrating the contour diagrams over the relative translational energy distributions are also given. (auth)

31131 SEMICLASSICAL THEORY OF INELASTIC MOLECULAR COLLISIONS: ROTATIONAL TRANSITIONS IN SMALL-ANGLE DIPOLE–DIPOLE SCATTERING. Gislason, E.A. (Department of Chemistry, University of Illinois at Chicago Circle, Chicago, Illinois 60680); Herschbach, D.R. J. Chem. Phys. 64: No. 5, 2133-2148 (1 Mar 1976).

The angular distribution of small-angle scattering is calculated for collisions of polar molecules. As found in previous calculations of the total cross section, the magnitude and form of the scattering vary drastically with the amount of inelastic energy transfer between rotation and translation. Collisions with various orientations of the increments Δj_1 and Δj_2 in the rotational momenta of the two molecules also give markedly different contributions. A semiclassical treatment of the inelastic scattering amplitude is used, with a random phase approximation for the strong-coupling realm at small impact parameters and the Born approximation for the weak-coupling realm at very large impact parameters. A classical time-dependent perturbation calculation is also carried out using a "flywheel" approximation which averages over the unperturbed rotational motion of the molecules during the collision. These small-angle scattering calculations give good agreement with the angular distribution measurements on $CsCl + SbCl_3$ made by Helbing and Pauly. The resolution correction for total cross section measurements is also derived from these calculations and is found to bring theoretical and experimental cross sections into reasonable correspondence for several systems. The main results are given as simple, closed formulas in terms of reduced variables and are compared with those for the spherically symmetric r^{-3} and r^{-6} potentials. (auth)

31132 QUANTUM MECHANICAL SCATTERING STUDIES USING 2D CUBIC SPLINE INTERPOLATION OF A POTENTIAL-ENERGY SURFACE. Sathyamurthy, N.; Kellerhals, G.E.; Raff, L.M. (Department of Chemistry, Oklahoma State University, Stillwater, Oklahoma 74074). J. Chem. Phys. 64: No. 5, 2259-2261 (1 Mar 1976).

The quantum mechanical scattering results for a collinear A+BC exchange reaction using an analytic surface are compared with those obtained by the use of the corresponding spline fitted surface. (AIP)

31133 LASER INDUCED ENERGY TRANSFER STUDIES IN POLYATOMIC MIXTURES: CH_3F–NO_2. Lee, S. M.; Ronn, A. M. (Brooklyn Coll. of the City Univ. of New York). Spectrosc. Lett. 8: No. 11, 915-930(1975).

The internal kinetics of NO_2 as well as the kinetics of crossover between CH_3F and NO_2 were studied in mixtures of these polyatomics and rare gases. Subsequent to excitation of the CH_3F to nu_3 equals 1 by the P(20) line of a 9.6 mu Q-switch CO_2 laser, fluorescence of NO_2 at 6.12 mu from nu_3 equals 1 was monitored. The equilibration rate of the stretching modes in NO_2 was determined to be 46 +- 10 $msec^{-1}$ $torr^{-1}$ while the rate of stretches-bend equilibration was measured as 15 +- 3 $msec^{-1}$ $torr^{-1}$. The rate of crossover from excited CH_3F to NO_2 in high rare gas dilution was measured as 90 +- 20 $msec^{-1}$ $torr^{-1}$ and the reverse rate as 285 +- 60 $msec^{-1}$ $torr^{-1}$. Comparison to other triatomic systems as well as other experiments with mixtures of polyatomics are made and implications of laser "photochemistry" of NO_2 reactions are discussed. (auth)

31134 DESIGN AND PERFORMANCE OF A HIGH INTENSITY COPPER ATOM BEAM SOURCE NOZZLE FOR USE IN INELASTIC ATOM–ATOM COLLISION EXPERIMENTS. Santavicca, D. A. Princeton, NJ; Princeton Univ. (1975). 192p. University Microfilms Order No. 76-267.

Thesis (Ph. D.).

The research was aimed at developing a neutral copper atom beam source which could be used to study the collision cross sections for electronic excitation of neutral copper atoms in

collision with neutral argon atoms. Of particular interest is the excitation from the ground state to the two upper laser levels at 3.80 and 3.82 electron volts. (Diss. Abstr. Int., B)

31135 THE SCATTERING OF POSITRONS BY HYDROGEN ATOMS. Chan, Y. F. London, Ont.; Univ. of Western Ontario (1972). 87p. INIS.

Thesis.

The S-wave scattering of positrons by hydrogen atoms in the energy region up to the first excitation threshold of hydrogen is studied. In the upper part of this energy region, the two reactions $e^+ + H(1s) \rightarrow e^+ + H(1s) \rightarrow Ps(1s) + H^+$ are possible, giving the open channels. The closed channel part of the wave function is approximated by a sum of short range correlation terms. Equations for the scattering functions and the coefficients of the expansion in the correlated terms are obtained variationally. The formulation satisfies the bound principle: the phase shift and the eigen phases are lower bound estimates to the exact values. Phase shifts are calculated for energies in both the elastic and inelastic scattering regions. A detailed hunt for resonances in the energy below the n = 2 excitation threshold of hydrogen produced negative results. As a test on the flexibility and capability of the trial wave function to produce a resonance, the same wave function without the positronium channel term is used to study the electron-hydrogen problem without exchange. Using a three-state approximation, a resonance is produced. At low energy, violent variations in phase shift are observed. An independent calculation, using a five-state close coupling approximation, produces similar results. The coupled integro-differential equations for the scattering functions are first converted to coupled integral equations, and the values of the functions at a specified net of points are obtained by solving a system of approximating linear algebraic equations. Numerical integrations are carried out using the Gauss-Legendre quadrature, if the limits are finite, or the Gauss-Laguerre formula, when the upper limit is infinite. (auth)

31136 CHARGE EXCHANGE BETWEEN HYDROGEN ATOMS AND FULLY STRIPPED HEAVY IONS. Salop, A. (Stanford Research Inst., Menlo Park, CA). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 975-978(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

Charge exchange between multicharged ions and background atomic and molecular gases represents one of the limitations to the attainment of high charge states in heavy ion sources, particularly containment sources. An attempt is made to study systematically a particularly simple but in many respects representative class of such reactions, namely charge transfer between atomic hydrogen and fully stripped heavy ions. Approximate cross sections for these processes in the low keV range of collision energies were obtained using a multistate Landau–Zener method. The energy and Z dependences of the cross sections are discussed. (auth)

31137 CHARGE EXCHANGE CROSS SECTIONS. Salzborn, E. (Univ., Giessen, Ger.). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 947-958(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

A review is presented on charge exchange cross sections of heavy ions at energies primarily in the range below 100 keV. Particular emphasis is given to the cross sections for capture of one or more electrons in single encounters of multiply charged ions with atoms. The system of the noble gases as projectile ions and target atoms is studied in detail. Systematic trends are examined. Attention is given to the influence of metastable ions on the cross sections. (auth)

31138 ELECTRON IMPACT IONIZATION. Dunn, G. H. (Joint Inst. for Laboratory Astrophysics, Boulder, CO). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 929-933(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

The discussion of electron impact ionization covers the concept that one can generalize or scale cross sections to easily predict unknown cross sections on the basis of known ones, an examination of the experimental methods of study and some of the recent experimental data. (JFP)

31139 L X-RAY PRODUCTION IN THE RARE EARTHS BY 0.33 TO 2.66 MeV/amu CARBON- AND 0.50 TO 2.25 MeV/amu OXYGEN-ION BOMBARDMENT. Pepper, G. H. Denton, TX; North Texas State Univ. (1975). 180p. University Microfilms Order No. 76-4411.

Thesis (Ph. D.).

Experimentally measured L-shell x-ray production cross sections are presented for 8 to 36 MeV oxygen-ion bombardment of Ce, Pr, Sm, Eu, Dy, and Ho; for 4 to 32 MeV carbon-ion bombardment of La and Yb; for 6 to 32 MeV carbon-ion bombardment of Pr, Nd, Sm, and Dy; and for 11 to 29 MeV carbon-ion bombardment of Ce, Eu, Gd, and Ho. Also presented are x-ray production cross sections for each of six experimentally resolvable peaks: Ll, L'alpha' (L $alpha_2$ + L $alpha_1$ + L eta), L'$beta_1$' (L $beta_1$ + L $beta_4$ + L $beta_3$ + L $beta_6$), L'$beta_2$' (L $beta_2$ + L $beta_{15}$ + L $beta_7$), L $gamma_1$, and L $gamma_{2,3}$. Theoretical predictions via the plane wave Born approximation (PWBA) with corrections for increased binding of target electrons and Coulomb deflection of the incident projectile tend to underestimate the experimental data; and this underestimation tends to get worse at the low- and high-energy ends of the range of energies used in this work. (Diss. Abstr. Int., B)

31140 K-SHELL AUGER ELECTRON PRODUCTION CROSS SECTIONS FROM ION BOMBARDMENT. Woods, C. W. Manhattan, KS; Kansas State Univ. (1975). 116p. University Microfilms Order No. 76-2956.

Thesis (Ph. D.).

The Ne K-shell electron spectra from a Ne gas target bombarded by 0.5 to 10 MeV H^+ and 0.16 to 2 MeV/amu N, O, F, and Cl ions in various incident charge states are studied experimentally. The F K-shell auger electron spectra are measured from F ion collisions with Ne gas from 3 to 15 MeV. Auger electron production cross sections are deduced. H^+ induced Ne K-shell Auger electron production cross sections are compared to various theoretical Coulomb ionization predictions. (Diss. Abstr. Int., B)

31141 INNER SHELL IONIZATION OF INTERMEDIATE- AND HIGH-Z ELEMENTS PRODUCED BY COLLISIONS WITH FAST HEAVY CHARGED PARTICLES. Hardt, T. L. College Station, TX; Texas A and M Univ. (1975). 247p. University Microfilms Order No. 76-3639.

Thesis (Ph. D.).

A review of the theoretical approaches to inner-shell ionization in fast ion-atom collisions is presented. K x-ray yields have been measured for ten elements ranging from Fe (Z equals 26) to Au (Z equals 79) using 30 to 100 MeV alpha particles and for Fe, Cu and Sn using 28.2 to 196.4 MeV carbon ions. The "smoothed" cross sections were used in comparisons with the predictions of the binary encounter approximation (BEA), the plane wave Born approximation (PWBA) and the binding corrected PWBA calculations and resulted in the observation of a systematic atomic-number dependent deviation between experiment and theory. By comparing the measured cross sections to the universal BEA curve at velocity ratios in which the mean electron velocity was calculated "semi"-relativistically, overall agreement within +-16 percent was obtained for all elements studied. The theoretically predicted z^2-dependence of the PWBA and BEA was tested by measuring the x-ray yield ratio of Cu using identical velocity alpha particles and deuterons and alpha particles and carbon ions. Cross sections for the ionization of the L-shell in seven elements ranging from Sn (Z equals 50) to Pb (Z equals 82) and for the L-subshells of Tb, Tm, Au and Pb were measured using 30 to 80 MeV alpha particles. Subshell ionization cross sections were deduced from the L alpha and L gamma x-ray lines and were compared to the predictions of the BEA, PWBA and the SCA. A computer program (ORION), written to compute theoretical cross sections based on the BEA, PWBA and the SCA, and to calculate the average depth of x-ray production and emission for a given target thickness and incident projectile, is also described. (Diss. Abstr. Int., B)

31142 EXCITATION OF ATMOSPHERIC GASES BY ELECTRON IMPACT (NITROGEN AND NITRIC OXIDE). Imami, M. Carbondale, IL; Southern Illinois Univ. (1975). 53p. University Microfilms Order No. 76-3317.

Thesis (Ph. D.).

Band emissions from the second positive (2PG) and first negative (1NG) systems of nitrogen were excited by secondary electrons in the pressure range of 10^{-4} -1 torr. The secondary electrons were produced in ionizing collisions between N_2 molecules and fast primary electrons. Band intensities were monitored inside and outside the interaction volume of the primary electron beam, enabling one to separate the contributions from secondary and primary electrons to the total excitation. The excitation of 2PG(0,0) band of nitrogen by electron impact was studied from threshold (11 eV) to 1000 eV. In view of the serious discrepancies in the existing cross section measurements for this band at higher energies (above 30 eV), the effects due to high pressures and secondary electrons were carefully studied. The excitation of several pronounced gamma-bands of NO by electron impact was studied from threshold to 1000 eV. (Diss. Abstr. Int., B)

31143 ABSOLUTE DIFFERENTIAL CROSS SECTIONS FOR 20 TO 800 eV ELECTRON-ARGON AND ELECTRON-MOLECULAR NITROGEN COLLISIONS FOR ELASTIC SCATTERING AND SECONDARY ELECTRON PRODUCTION. DuBois, R. D. Lin-

coln, NE; Univ. of Nebraska (1975). 173p. University Microfilms Order No. 76-2016.

Thesis (Ph. D.).

Elastic cross sections, differential in angle, were measured for 20 to 800 eV electrons elastically scattered from argon atoms and nitrogen molecules. Scattering angles ranged from 2 to 153°. Within error bars, the present results agree with the measurements of Bromberg and Jansen, et al., in the limited regions of overlap. Present theories fail to accurately reproduce the sharply increasing cross sections for small angles or the interference minima in argon and do not exist for N_2. Doubly differential cross sections for secondary electron production were also measured for the same collisions. (Diss. Abstr. Int., B)

31144 RELATIVISTIC EFFECTS IN INELASTIC ELECTRON-MERCURY SCATTERING AT 25 eV TO 180 eV. Calhoun, R. V. Jr. Tallahassee; Florida State Univ. (1975). 96p. University Microfilms Order No. 76-2627.

Thesis (Ph. D.).

A relativistic distorted-wave approximation is developed for handling inelastic electron-heavy atom collisions. The relativistic distorted-wave approximation is developed in a jj-coupling scheme with the distorted-waves given by solutions of the Dirac equation for a central field. The theory is applied to the $^1S_0$-$^1P_1$ transition in mercury, for the energy range 25 eV to 180 eV, to ascertain the importance of relativistic effects at low energies. Results of this calculation are compared to a distorted-wave calculation using relativistic potentials and non-relativistic wave functions. (Diss. Abstr. Int., B)

31145 SIMULTANEOUS IONIZATION AND EXCITATION OF HELIUM TO THE 4S,P,D,F STATES OF He^+ BY ELECTRON IMPACT. Evans, W. D. Madison, WI; Univ. of Wisconsin (1975). 129p. University Microfilms Order No. 75-23,841.

Thesis (Ph. D.).

The simultaneous ionization and excitation process of helium by electron impact has been studied by observing the fine structure of the He II 4686 A radiation (4S,4P,4D,4F yields 3S,3P,3D) at electron energies of 80 to 300 eV. A dual etalon 150 mm aperture, high-resolution scanning Fabry–Perot interference spectrometer was used to resolve the thirteen fine structure components. The ionization-excitation cross sections of the 4S states are in reasonable agreement with theoretical values. Over the energy range of 4P cross sections are about three times larger than the 4S and 4D cross sections, which are of comparable magnitude, and much larger than the 4F cross sections. The pressure dependence of the apparent excitation cross sections was measured at an electron energy of 200 eV over the region 2 to 140 milli-torr at 85°K and 18 to 140 milli-torr at 300°K. (Diss. Abstr. Int., B)

31146 ELECTRON EXCITATION OF HYDROGEN USING AN EXTENDED GLAUBER APPROXIMATION. Gau, J. N. Jr. Lincoln, NE; Univ. of Nebraska (1975). 79p. University Microfilms Order No. 76-2021.

Thesis (Ph. D.).

Elastic and inelastic electron-hydrogen scattering is considered using an unrestricted version of the Glauber approximation. The integral expressions that are derived are shown to reduce to those of the restricted Glauber approximation when q yields 0 for 1s yields ns excitation and to give the same divergent behavior as the conventional restricted Glauber approximation when q, the momentum transfer, approaches zero. The integrals for the electron-electron and the electron-nucleus interactions can be separated and evaluated analytically in the asymptotic limit of large q. The electron-nucleus term is shown to be dominant and to have Rutherford-like dependence on q for fixed energy at large q. Cross sections and Fano–Macek alignment and orientation parameters have been computed numerically for various scattering angles and incident energies. The total cross sections and polarization fraction of Ly-alpha radiation agree closely with Byron's Monte-Carlo integrations of the generalized Glauber transition matrix. The states excited as a function of scattering angle are found to be elliptically polarized in our calculations in contrast to the predictions of the Born and conventional eikonal-type approximations. (Diss. Abstr. Int., B)

31147 CHARGE TRANSFER TO H(2p), H(2s), AND H^- IN PROTON–XENON COLLISIONS. Martin, P. J. Lincoln, NE; Univ. of Nebraska (1975). 124p. University Microfilms Order No. 76-4530.

Thesis (Ph. D.).

High frequency structures have been observed in the measured total cross sections for forming H(2s), H(2p), and H^- in proton-xenon collisions for an incident proton energy range of 0.5 to 5.0 keV. Oscillatory behavior in total cross sections has been interpreted by Rosenthal and Ankudinov, Bobashev, and Perel as resulting from coherent non-adiabatic coupling of the amplitudes of outgoing inelastic channels at large internuclear separation. Using the potential energy curves of $(HXe)^+$ calculated by Kubach and Sidis to determine the relative phases of H(2s) and H(2p), it is shown that the total cross sections for forming these states exhibit interference effects that are 2 to 3 orders of magnitude smaller than the effects in the present measurement. An analysis of the observed structure in the total cross sections indicates that three frequencies are present in the H(2p) total cross section while single frequencies are present in the H^- and H(2s) total cross sections. These single frequencies are common to the frequencies found in the H(2p) total cross section. Further analysis indicates that there is a strong coupling between these three outgoing channels. A mechanism based on molecular orbital curve crossings is presented to explain the data. (Diss. Abstr. Int., B)

31148 DIFFERENTIAL CROSS SECTION FOR K-SHELL IONIZATION BY RELATIVISTIC ELECTRONS. Konar, A. N. (Jaipuria Coll., Calcutta). Acta Phys. Acad. Sci. Hung.; 38: No. 4, 337-339(1975).

The results of a recent work by Das (Nuov Cim. 12B, 197, 1972), which may be used in the study of differential cross sections for the inner shell ionization of atoms by relativistic electrons, are discussed. It is concluded that for scattering at small angles the theoretical results of Das may be used and this may also be used for scattering at large angles and for large detected electron energy. But for large angles and low energies the results of Das must be used after integrating over the scattered electron directions. (JFP)

31149 MEASUREMENT OF RELATIVE EFFECTIVE CROSS SECTIONS FOR COLLISIONS OF THE SECOND KIND OF $Cd(5^3P_1)$ ATOMS WITH SLOW ELECTRONS. Korotkov, A.I.; Gurev, Yu.S.; Kazakov, S.M. Opt. Spectrosc. (USSR) 39: No. 6, 590-593 (Dec 1975).

Relative effective cross sections for collisions of the second kind for the process $Cd(5\ ^3P_1)+e \rightarrow Cd(5\ ^1S_0)+e+\Delta W$ were measured in the energy range of slow electrons from 0.6 eV to 4 eV. The beam of slow electrons was formed using Hanle's double field method. Electrons which experienced collisions of the second kind hit the collector and were recorded by an electrometer. Atoms were excited to the $Cd(5\ ^3P_1)$ level by optical pumping from an external light source. An analytic foundation is given for the existence of a primary maximum of the de-excitation function of the $Cd(5\ ^3P_1)$ level. (auth)

31150 CHARACTER OF HELIUM EXCITATION IN THE NEGATIVE GLOW OF A GLOW DISCHARGE. Soldatov, A.N.; Muravev, I.I.; Karimov, R.G.; Evtushenko, G.S. Opt. Spectrosc. (USSR) 39: No. 6, 594-597 (Dec 1975).

The mechanism by which the radiating levels of helium atoms are excited in the plasma of the negative glow of a normal and slightly anomalous discharge is analyzed using the results of a complex investigation of the spatial distribution of the optical and electrokinetic characteristics (the density and energy distribution function of the electrons). It is shown that even at helium pressures of 2–10 Torr the population of the upper levels in the brightest region of the glow is due mainly to electron collisions from the ground state of the atom. Estimates of direct electron excitation from the absolute intensities of the 5016-Å HeI and 4686-Å HeII spectral lines enable us to extend this conclusion to higher pressures (up to 30 Torr). (auth)

31151 LUMINESCENCE OF MOLECULAR BANDS ON EXCITATION OF HELIUM WITH AN ELECTRON BEAM. Bogdanova, I.P.; Frish, S.F.; Yakovleva, V.I. Opt. Spectrosc. (USSR) 39: No. 6, 674-674 (Dec 1975).

Excitation functions were determined for the luminescence of molecular band in He due to electron beam excitation. The pressure dependence of the intensity of the band was noted. (AIP)

31152 DISSOCIATIVE EXCITATION OF HYDROGEN IN THE AFTERGLOW OF A DISCHARGE IN MIXTURES OF H_2 AND D_2 WITH HELIUM AND NEON. Bochkova, O.P. Opt. Spectrosc. (USSR) 39: No. 6, 682-683 (Dec 1975).

The radiation of the lines from the Balmer series was observed in the afterglow of a discharge in a mixture of H_2 and D_2 with He_4 and Ne. The spectra was due to dissociative excitation of atomic hydrogen. The change in brightness as a function of pressure was also studied. (AIP)

31153 EMISSION CROSS SECTIONS FOR THE BALMER Hα, Hβ, Hγ LINES PRODUCED BY 10–100 keV PROTON IMPACT ON N_2 AND O_2. Lenormand, J.; Le Doucen, R. (Rennes-1 Univ., 35 (France)). Rev. Phys. Appl.; 10: No. 5, 257-261(Sep 1975). (In French).

Absolute cross sections have been measured for the emission of the Balmer Hα, Hβ, Hγ lines produced by 10–100 keV proton impact on N_2 and O_2. The polarization of the Hα and Hβ lines has been determined for these gases from 10 to 60 keV. The cross sections show a similar dependence on impact energy for different lines, except at low energy for Hβ and Hγ in N_2. (FR)

31154 REACTIVE SCATTERING OF OXYGEN ATOMS. Radlein, D. S. A. G.; Whitehead, J. C.; Grice, R. (Cambridge Univ. (UK)). pp (no. D-1) 8 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975).

Angular and velocity distribution measurements have been made of 10 reactive scattering from O + I_2, ICl. The data are in excellent agreement with the model previously used for long-lived collision complex mechanism. The presence of a significant orientation requirement for reaction is deduced. (FR)

31155 ATTEMPT TO COMPUTE THEORETICALLY THE CROSS SECTION FOR METASTABILITY TRANSFER BETWEEN MERCURY ATOMS IN THE 6 $^1S_0$ AND 6 $^3P_0$ LEVELS. Barrat, J. P.; Vienne-Casalta, D. (Caen Univ., 14 (France)). J. Phys. (Paris); 36: No. 10, 919-921(Oct 1975). (In French).

It is shown by means of a simple model that one can relate the cross section for metastability transfer collisions between mercury atoms in the 6 $^3P_0$ state and in the ground state to the constant C for the Van der Waals interaction between atoms in these levels. Reasonable agreement between theory and experiment is found if one takes: $C \sim 300\ eV \times A^6$. (FR)

31156 ALIGNMENT-ORIENTATION COUPLING BY COLLISIONS IN HIGH MAGNETIC FIELDS. Gay, J. C. (Ecole Normale Superieure, 75 - Paris (France); Paris-7 Univ., 75 (France)). J. Phys. (Paris), Lett.; 36: No. 10, L.239-L.242 (Oct 1975). (In French).

Using a simple theoretical model the occurrence of orientation in an aligned vapor is predicted when the atoms undergo collisions in a high magnetic field. The main condition for this to occur is that the Larmor precession of the excited states of the atoms is not negligible during the collision. The order of magnitude of the effect for a R^{-6} Van der Waals interaction is given and possible conditions for observing it experimentally are described. (FR)

31157 ANGULAR CORRELATION OF PHOTONS FROM POSITRON ANNIHILATION IN COPPER-NICKEL ALLOYS. Hasegawa, M. (Tohoku Univ., Oarai, Ibaraki (Japan). Irradiation Research Lab.); Suzuki, T.; Hirabayashi, M. J. Phys. Soc. Jpn.; 37: No. 1, 85-91(Jul 1974).

Angular correlation measurements of radiation from positrons annihilating in copper-nickel alloys have been carried out with crossed-slit geometry using single crystals containing less than 73 at % Ni. The neck radius of the Fermi surface decreases linearly with increasing nickel content, but the neck does not detach from the hexagonal zone face even at the highest nickel content. No marked change in the composition dependence of neck radius is observed at the magnetic phase boundary near 70% Ni. The neck radius of paramagnetic nickel is estimated to be about 0.13 in unit of that for copper from the extrapolation of the observed data. (auth)

31158 EXCITATION OF MAGNESIUM IONS DURING SLOW, ELECTRON–ION COLLISIONS. Kel'man, V. A. (Uzhgorod State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 35-39(1975). (In Russian).

By a method of intersecting, modulated beams, measurements were made of the absolute excitation functions of 3s-3p- and 3p-4s-transitions of Mg II during collisions of electrons with magnesium ions from the excitation threshold up to 100 eV. (tr-auth)

31159 EFFECT OF A NONPAIR INTERACTION OF ION–MOLECULE REACTION IN THE SYSTEM He + H_2^+. Golubkov, G. V.; Manakhov, L. V. (Physical Chemistry Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 4, 276-280 (1975).

Translated from Khim. Vys. Energ.; 9: No. 4, 316-321(1975).

The effect of a nonpair interaction on the mechanisms of simple reactions in the system He + H_2^+ are discussed within the framework of the low-radius potential model. In particular, it is shown that the decomposition of highly excited H_2^+ molecules during collisions with helium atoms close to the dissociation threshold occurs via the formation of the intermediate complex HeH^+. This makes it possible to obtain the temperature dependence of the rate constant for the reverse recombination process, $k \sim T^{-5/2}$. It is shown that owing to the nonpair interaction the electronic transition $1s\sigma_g \rightarrow 2p\sigma_u$ occurs, leading to decomposition of the H_2^+ molecule. (auth)

31160 YIELDS OF $N_2(C)$ FROM $Ar^* + N_2$ AND XeBr* FROM $Xe^* + Br_2$. Searles, S.K.; Hart, G.A. (Naval Research Laboratory, Washington, D.C. 20375). Appl. Phys. Lett. 28: No. 7, 384-386 (1 Apr 1976).

Investigation of reactions I and II, where * represents a low-lying electronically excited state, $Ar^* + N_2 \rightarrow N_2(C) + Ar$ (reaction I) and $Xe^* + Br_2 \rightarrow XeBr^* + Br$ (reaction II), was carried out by e-beam excitation of Ar-N_2 mixtures and Xe-Cr_2 mixtures. Analysis of the fluorescence data and e-beam energy deposition led to yields of 0.20 $N_2(C)$ for Ar^* and 0.30 XeBr* for Xe^*. (auth)

31161 GLAUBER CROSS SECTIONS FOR THE $2s \rightarrow 2p$ RESONANCE EXCITATION IN LITHIUM BY ELECTRON IMPACT. Kumar, S.; Srivastava, M.K. (Department of Physics, University of Roorkee, Roorkee-247667, India). Phys. Rev. A 13: No. 4, 1307-1311 (Apr 1976).

The cross sections for the electron-impact-induced resonance transition ($2s \rightarrow 2p$) in lithium are calculated in the Glauber approximation using Franco's method of explicitly involving all the electrons of the many-electron target. Our results are always a bit smaller than the frozen Glauber results, but approach them as the energy increases. However, these differences are not very significant, indicating that the inner electrons (those in 1s state) are rather inert. Both of the Glauber results are found to be in good agreement above 15 eV with the recent experimental results of Leep and Gallagher. (auth)

31162 CHARGE EXCHANGE BETWEEN H(1s) AND FULLY STRIPPED HEAVY IONS AT LOW-keV IMPACT ENERGIES. Salop, A.; Olson, R.E. (Molecular Physics Center, Stanford Research Institute, Menlo Park, California 94025). Phys. Rev. A 13: No. 4, 1312-1320 (Apr 1976).

Approximate cross sections for charge transfer between ground-state atomic hydrogen and completely stripped ions of C, N, O, Ne, Si, and Ar have been obtained in the velocity range 6×10^6–7×10^7 cm/sec. In these collisions, electron capture occurs predominantly into high-lying orbitals of the product heavy ion. The calculations are made using the Landau-Zener theory modified for application to a multistate system. The peak cross sections are found to increase by about a factor of 5 in going from C^{+6} ($\simeq 21$ Å^2) to Ar^{+18} ($\simeq 110$ Å^2) and the cross-section curves tend to "flatten out" for the heavier ions where three or four crossings contribute to the charge exchange. At the higher energies, the cross sections become roughly equal to $1.4 \times 10^{-16} Z^{3/2}$ cm^2. (auth)

31163 CHARGE EXCHANGE BETWEEN H(2s) AND FULLY STRIPPED CARBON AND NITROGEN IONS AT LOW-keV IMPACT ENERGIES. Salop, A. (Molecular Physics Center, Stanford Research Institute, Menlo Park, California 94025). Phys. Rev. A 13: No. 4, 1321-1325 (Apr 1976).

Approximate cross sections for charge transfer between H(2s) and fully stripped carbon and nitrogen ions have been obtained in the velocity range 6×10^6–7×10^7 cm/sec. In these systems, transfer takes place into high-lying orbitals of the final-state ion. The Landau-Zener theory modified for application to a multistate system is used to calculate the cross sections. The coupling-matrix elements are determined both from a study of the pseudocrossings observed in the relevant system of the adiabatic potential curves and by direct calculation using the appropriate asymptotic parabolic wave functions. The resulting cross sections are large, in the 10^{-14}-cm^2 range for both C^{+6} and N^{+7}, and show the relatively flat energy dependence characteristic of systems with a number of contributing curve crossings. (auth)

31164 INNER-SHELL EXCITATIONS AND IONIZATIONS OF ATOMIC IONS BY HIGH-ENERGY ELECTRON IMPACT. Hahn, Y. (Department of Physics, University of Connecticut, Storrs, Connecticut 06268). Phys. Rev. A 13: No. 4, 1326-1333 (Apr 1976).

Cross sections for the inner-shell ionization of argon ions by high-energy electron impact are estimated. An improved form of the single-particle model with varying degrees of ionization is used in the calculation of the excitation amplitudes. Partial sums over the allowed final states are carried out using the semiclassical projection operator. This operator depends on a spectral cutoff parameter e_b, and a method for its determination is examined for the case of hydrogenic transitions. The ionization cross section incorporates both the direct excitation to the continuum and the Auger emission following the inner-shell excitations. For electron energies in the KeV range and for atomic targets with the core charges Z_C less than 20, the direct ionization dominates, with the excitation Auger-emission mode making a small but appreciable contribution. The ionization cross sections for the neutral neon, and oxygen targets are also estimated. (auth)

31165 PROJECTILE CHARGE AND ENERGY DEPENDENCE OF TITANIUM *K* X RAYS AND SATELLITES FOLLOWING EXCITATION BY FAST HEAVY IONS. Hill, K.W. (University of North Carolina, Chapel Hill, North Carolina 27514); Doyle, B.L.; Shafroth, S.M.; Madison, D.H.; Deslattes, R.D. Phys. Rev. A 13: No. 4, 1334-1343 (Apr 1976).

High-resolution measurements have been made of Ti $K\alpha$ x rays and satellites (KL^n, $n = 0$–4) following bombardment of thick Ti targets by H^+, He^{n+}, Li^{n+}, C^{n+}, and O^{n+} ions at energies of 1–5 MeV/amu. A

systematic study was made of the effect of projectile atomic number Z_1 and energy E_1 upon the relative intensities, centroid energies, and widths of the various x-ray peaks. The intensity of the satellite structure relative to the diagram lines ($K\alpha_1$, α_2) increases with increasing Z_1 for the same-velocity projectile up to $Z_1 = 8$. Both the Z_1 and E_1 dependence of these intensities agree reasonably well with a theoretical model described elsewhere. Deviations of peak intensities from theory are discussed. Centroid energies of the peaks increase approximately linearly with Z_1 at a rate of ~ 1 eV/Z. These energy shifts are compared with Hartree-Fock calculations of the x-ray energies for various members of M-shell ($3s$ and $3p$) electronic vacancies. Peak widths range from 10 to 37 eV, increasing monotonically with Z_1 for most peaks and increasing monotonically with n for all projectiles. No variation of centroid positions or peak widths was observed for different values of E_1 and fixed Z_1. The observed energy shifts and peak-width variations are discussed in terms of ionization of the M shell, varying distributions of L-shell vacancies among the $2s$ and $2p$ subshells, and possible multiplet splittings. (auth)

31166 K-SHELL X–RAY PRODUCTION CROSS SECTIONS FOR ^{12}C, ^{14}N, AND ^{16}O IONS ON Ni, Rb, Ag, AND Sb: 0.4–2.4 MeV/amu. Gray, T.J.; Richard, P.; Kauffman, R.L. (Physics Department, Kansas State University, Manhattan, Kansas 66506); Holloway, T.C.; Gardner, R.K.; Light, G.M.; Guertin, J. Phys. Rev. A 13: No. 4, 1344-1351 (Apr 1976).

K-shell x-ray production cross sections for ^{12}C, ^{14}N, and ^{16}O ions on thin targets of Ni, Rb, Ag, and Sb were measured over the incident-ion energy range of 0.4–2.4 MeV/amu. Comparisons to theoretical predictions of the binary-encounter, semiclassical, and plane-wave Born approximations (PWBA) show that these theories overpredict the magnitude of the measured cross sections. The PWBA calculations with perturbation corrections for binding energy and Coulomb deflection effects included are in better agreement with the measured data for $E/M < 1.2$ MeV/amu. Comparison of the data to the perturbed PWBA calculations which also include corrections of electron polarization effects in the case of ^{12}C on Ni gives good agreement between these theoretical estimates and the measured K-shell x-ray production cross sections. (auth)

31167 TOTAL RELATIVE DIFFERENTIAL CROSS SECTION FOR 500-eV AND 1-keV ELECTRONS SCATTERED BY NITROGEN (N_2). Peixoto, E.M.A.; Nogueira, J.C. (Instituto de Quimica, Departamento de Quimica Fundamental, Universidade de São Paulo, Cidade Universitária, Cxa. Postal 20780, São Paulo, S.P., Brasil). Phys. Rev. A 13: No. 4, 1352-1357 (Apr 1976).

We measured total relative differential cross sections for electron collisions with molecular nitrogen. Results are presented between 6°–80° with 500-eV electrons and 2°–90° with 1-keV electrons. Theoretical calculations were also done utilizing partial waves for elastic channel and the Born approximation for the total inelastic cross section. In both cases use was made of Hartree-Fock-Clementi wave functions. The agreement between our theoretical and experimental results is analyzed, demonstrating the possibility of determining molecular-structure parameters at 1 keV. (auth)

31168 K-SHELL AUGER-ELECTRON PRODUCTION CROSS SECTIONS FROM ION BOMBARDMENT. Woods, C.W.; Kauffman, R.L.; Jamison, K.A.; Stolterfoht, N.; Richard, P. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. A 13: No. 4, 1358-1369 (Apr 1976).

We have measured the Ne K-shell electron spectra from a Ne gas target bombarded by 0.5–10 MeV H^+ and 14–21 MeV N, 24–35 MeV O, 3–35 MeV F, and 40 and 50 MeV Cl in various incident ionic charge states. The F K-shell Auger-electron spectra have been measured for F-ion collisions with Ne gas from 3 to 15 MeV. Auger-electron production cross sections are deduced. H^+ induced Ne K-shell Auger-electron production cross sections are compared to various theoretical Coulomb ionization predictions. The heavy-ion–induced Ne K-shell Auger-electron production cross sections increase with increasing projectile charge state at constant projectile energy. The F and Ne K-shell Auger-electron production cross sections from 3 to 15 MeV are favorably compared to calculations based on the molecular-orbital model. (auth)

31169 CHARGE-EXCHANGE FORMATION OF Ar^- IN D^--ON-Ar COLLISIONS. Edwards, A.K. (Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). Phys. Rev. A 13: No. 4, 1654-1654 (Apr 1976).

The charge-exchange formation of the $^2P_{3/2,1/2}$ states of Ar^- formed by D^--on-Ar collisions is measured. The autodetached electrons ejected from the Ar^- states are observed at 125.3° from the beam direction. These results are compared with similar measurements made with an H^- ion beam. A dip in the cross section occurs at 1.5 keV beam energy for the H^- and at 3 keV for the D^-. As a function of beam velocity the exchange cross sections are the same up to the velocity corresponding to 2-keV H^- (4-keV D^-). At higher velocities the D^- results are greater. (auth)

31170 ABSOLUTE ELASTIC DIFFERENTIAL ELECTRON SCATTERING CROSS SECTIONS IN THE INTERMEDIATE ENERGY REGION. III. SF_6 AND UF_6. Srivastava, S.K.; Trajmar, S.; Chutjian, A.; Williams, W. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103). J. Chem. Phys. 64: No. 7, 2767-2771 (1 Apr 1976).

A recently developed technique has been used to measure the ratios of elastic differential electron scattering cross sections (DCS) for SF_6 and UF_6 to those of He at electron impact energies of 5, 10, 15, 20, 30, 40, 50, 60, and 75 eV and at scattering angles of 20° to 135°. In order to obtain the absolute values of DCS from these ratios, He DCS of McConkey and Preston have been employed in the 20° to 90° range. At angles in the 90° to 135° range the recently determined cross sections of Srivastava and Trajmar have been utilized. From these DCS, elastic integral and momentum transfer cross sections have been obtained. (auth)

31171 ASSOCIATIVE IONIZATION IN COLLISIONS BETWEEN METASTABLE HELIUM AND ATOMIC NITROGEN AND OXYGEN. Neynaber, R.H.; Magnuson, G.D. (IRT Corporation, P.O. Box 80817, San Diego, California 92138). J. Chem. Phys. 64: No. 7, 2840-2844 (1 Apr 1976).

Absolute and relative cross sections were obtained for the associative ionization (AI) reactions $He^* + N \rightarrow HeN^+ + e$ and $He^* + O \rightarrow HeO^+ + e$ by a merging-beams technique from nominally 0.01 to 1.5 eV for the first reaction and 0.01 to 0.2 eV for the second. The He^* represents a composite of $He(2\,^1S)$ and $He(2\,^3S)$, and the N and O represent composites of ground and metastable states. Although the observation of AI between two excited reactants is rare, evidence is presented for such an observation between excited He and excited N. (auth)

31172 COLLISIONAL IONIZATION AND ELASTIC SCATTERING IN ALKALI–HALOGEN ATOM COLLISIONS. Faist, M.B.; Levine, R.D. (Department of Chemistry, The Ohio State University, Columbus, Ohio 43210). J. Chem. Phys. 64: No. 7, 2953-2970 (1 Apr 1976).

Close-coupling (two-state) computations for collisional ionization and elastic scattering in Na+I and Li+I collisions have been made, using realistic model potentials, at a large range of postthreshold energies. At the higher energies a generalized JWKB procedure was employed which yields a very accurate scattering matrix when compared to a fully quantal solution. The computed elastic and inelastic total and differential cross sections are discussed and compared to the predictions of more approximate methods. The rainbow angles in the angular distribution are compared to those predicted by the classical deflection function obtained from the trajectories along adiabatic or diabatic potential curves (based on the assumption of a single transition point). It is found that at all energies considered these rainbow positions agree best for trajectories computed via the adiabatic representation rather than the diabatic representation. The double rainbow pattern noted in the elastic ionic channel can be interpreted only within the adiabatic representation. Landau–Zener–Stueckelberg (LZS) computations for the energy dependence of the collisional ionization cross section have also been made. The LZS curve jumping mechanism is in better agreement with the quantal results when the transition is taken to occur at the adiabatic coupling point (R_p) rather than the diabatic crossing point (R_x). Moreover, depending on the nature of the potentials, there may also be an additional transition region at small internuclear distances, which is not present in the LZS scheme but may be the source of oscillations found in the post maximum energy dependence of the collisional ionization cross section. The systematics of the collisional ionization cross sections for all alkali metal–halogen atom (M+X) collisions are discussed and the energy dependence of the cross section is computed using realistic potentials. In terms of the reduced velocity (at the crossing point) v/K_p, it is noted that only Li+I and Na+I are in the strong coupling region. For all other systems the cross section is found to decrease with increasing collision energy. (auth)

31173 COMPUTATIONAL STUDY OF ELASTIC AND ELECTRONICALLY INELASTIC SCATTERING OF Br BY GROUND STATE I ATOMS: ROLE OF POTENTIAL CURVE CROSSING. Faist, M.B.; Bernstein, R.B. (Departments of Chemistry and Physics, The University of Texas at Austin, Austin, Texas 78712). J. Chem. Phys. 64: No. 7, 2971-2984 (1 Apr 1976).

Two-state, close-coupled quantal computations of the elastic and inelastic scattering of ground-state I atoms by ground-state Br and spin–orbit excited Br^* atoms have been carried out over a range of total energies E from 0.01 to 0.94 eV. The possibility of translational–electronic energy transfer arises from the $^3\Pi_{0+}$ potential curve crossing at E=0.25 eV, responsible for the well-known IBr predissociation. The Y, B, and $V_{12}(R)$ diabatic potentials have been obtained by judicious extension (and manipulation) of the spectroscopically derived $\bar{B}$ and $\bar{B}'$ adiabats. At energies below the threshold for Br^* formation (E_{th}=0.457 eV) collisions of I+Br are necessarily elastic, exhibiting both shape and compound-state resonances. These produce interesting interference patterns in the differential cross sections, but no significant inverse-predissociation resonance (which

might have been anticipated for $E \geq 0.25$ eV). The main features of the elastic scattering can be fairly well approximated considering only the lower adiabat, even at postthreshold energies where the inelastic process becomes important. An oscillatory pattern found in the total elastic cross section has been identified with a barrier effect associated with the maximum in this $\bar{B}$ adiabat. Total inelastic cross sections are well reproduced by the closed-form Landau–Zener–Stueckelberg (LZS) approximation. The Boltzmann-averaged LZS rate constant for the collisional deactivation $I + Br^* \rightarrow I + Br$ is calculated to be 1.8×10^{-11} cm^3 sec^{-1} at 300 K (with only a slight temperature dependence over the range 300–1000 K). This large rate is due to the inverse predissociation mechanism, common to all heteronuclear interhalogens, but absent for the homonuclear diatomics (because of their inversion symmetry). Implications of this "selectivity" with respect to bulk photochemical kinetics of the halogens are discussed. (auth)

31174 A DECOUPLED *l*-DOMINANT APPROXIMATION FOR ION–MOLECULE AND ATOM–MOLECULE COLLISIONS. DePristo, A.E.; Alexander, M.H. (Department of Chemistry, University of Maryland, College Park, Maryland 20742). J. Chem. Phys. 64: No. 7, 3009-3013 (1 Apr 1976).

In the space-fixed frame we develop a novel angular decoupling approximation, which involves the degree of alignment between the molecular and total rotational angular momentum vectors. When grafted onto the recent *l*-dominant method, this decoupling results in a set of block-diagonalized coupled equations of dimensionality equivalent to that of the body-fixed coupled-states (CS) equations. In direct contrast to the CS method, we expect the "decoupled *l*-dominant" (DLD) method to be best suited for the study of collisions in which strong long-range forces play a major role. We have applied the DLD method to the determination of partial and total cross sections for rotationally inelastic Ar–N_2 and Li^+–H_2 collisions. The agreement with exact close-coupling values is very satisfactory, except in those cases where collisions at large impact parameter do not contribute significantly to a particular transition. (auth)

31175 A STUDY OF THE REACTIONS OF C^+ AND O^+ WITH CARBON DIOXIDE. Rutherford, J.A.; Vroom, D.A. (IRT Corporation, P.O. Box 80817, San Diego, California 92138). J. Chem. Phys. 64: No. 7, 3057-3059 (1 Apr 1976).

Crossed ion neutral beam techniques have been employed to investigate the reactions $C^+ + CO_2 \rightarrow CO^+ + CO$, $O^+ + CO_2 \rightarrow O + CO^+{}_2$, and $O^+ + CO_2 \rightarrow O^+{}_2 + CO$. Cross sections for the first reaction have been obtained in the ion energy range from 0.5–25 eV, while for the second process the range of measurement was 0.5–500 eV. Signals attributed to the third reaction could only be detected at ion energies less than 0.5 eV. Both ion–molecule reactions exhibit an energy dependence which falls off with increasing interaction energy faster than the $1/v$ dependence often found for such processes. The charge transfer process, which is endothermic by approximately 0.15 eV, is observed to have a finite cross section at the lowest ion energy employed. (auth)

31176 AN EXACT QUANTUM MECHANICAL TREATMENT OF CHARGE TRANSFER AT LOW ENERGIES FOR THE $H^+ + H_2$ REACTIVE COLLINEAR SYSTEM. Top, Z.H.; Baer, M. (Soreq Nuclear Research Center, Yavne, Israel). J. Chem. Phys. 64: No. 7, 3078-3079 (1 Apr 1976).

Quantum mechanical calculations for the reactive charge transfer collinear system $H^+ + H_2(v)$ are reported. (AIP)

31177 MAGNETIC SPLITTING OF QUASIMOLECULAR ELECTRONIC STATES IN STRONG FIELDS. Rafelski, J.; Müller, B. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 36: No. 10, 517-520 (8 Mar 1976).

The heavy-ion motion in sub-Coulomb collisions generates extreme magnetic fields. The hyperfine splitting of the spin-1/2 quasimolecular electronic states in $U + U$ is found to reach 10% of the molecular binding energy (100 keV). Also Pb+Pb and Xe+Xe collisions are considered. (auth)

31178 PROJECTILE ATOMIC-NUMBER DEPENDENCE FOR *K*-SHELL HOLE PRODUCTION. Reading, J.F.; Ford, A.L.; Fitchard, E. (Cyclotron Institute and Physics Department, Texas A & M University, College Station, Texas 77843). Phys. Rev. Lett. 36: No. 11, 573-576 (15 Mar 1976).

An accurate numerical calculation of the projectile atomic-number dependence for *K*-shell hole production by Coulomb excitation has been carried out through the two leading terms in the plane-wave Born series. The calculation is restricted to velocities where the projectile is slower than the target *K*-shell electron, but fast enough that Coulomb deflection of the projectile is negligible. Agreement is found with experiments. (auth)

31179 PHOTON VECTOR POLARIZATION AND COHERENCE PARAMETERS IN AN ELECTRON-PHOTON COINCIDENCE EXPERIMENT ON HELIUM. Standage, M.C.; Kleinpoppen, H. (Institute of Atomic Physics, University of Stirling, Stirling, FK9 4LA, Scotland). Phys. Rev. Lett. 36: No. 11, 577-580 (15 Mar 1976).

We present linear and circular polarization measurements of $3^1P - 2^1S$ (501.6 nm) photons detected in delayed coincidence with electrons inelastically scattered from the 3^1P level of helium. Vector polarization and coherence parameters of the concident radiation provide direct experimental evidence of the coherent nature of the excitation polarization and coherence parameters of the coincident radiation provide polarization measurements. Analysis of the data also yields λ and χ parameters for 3^1P excitations, which are compared with previous data and theory. (auth)

31180 DIRECT OBSERVATION OF A RAMSAUER-TOWNSEND EFFECT IN POSITRON-ARGON COLLISIONS. Kauppila, W.E.; Stein, T.S.; Jesion, G. (Wayne State University, Detroit, Michigan 48202). Phys. Rev. Lett. 36: No. 11, 580-584 (15 Mar 1976).

Transmission measurements of the total scattering cross section for positrons of well-defined energy colliding with argon atoms in the energy range extending from 0.4 to 18 eV reveal a shallow minimum in the vicinity of 2 eV. The measured total cross section at the minimum is 2.4×10^{-16} cm^2. These measurements also reveal an abrupt increase in the total cross section above the threshold for positronium formation (9.0 eV). (auth)

31181 COLLISIONAL QUENCHING OF METASTABLE X-RAY—EMITTING STATES IN A FAST BEAM OF HE-LIKE FLUORINE. Matthews, D.L.; Fortner, R.J.; Bissinger, G. (University of California, Lawrence Laboratory, Livermore, California 94550). Phys. Rev. Lett. 36: No. 12, 664-667 (22 Mar 1976).

High-resolution x-ray spectral measurements are used to determine the relative intensity of He-like fluorine x-ray transitions, $2^3P_1 \rightarrow 1^1S_0$ and $2^1P_1 \rightarrow 1^1S_0$, produced in 30-MeV F^{5+} collisions with Ne, Ar, and Kr gas targets at various pressures. The relative intensities are observed to be strong functions of both gas pressure and target Z. The data permit extraction for the first time of the total quenching cross sections (σ_Q) for fast fluorine ions in the $1s2p\ ^3P_1$ state. The measured σ_Q are found to be approximately geometrical in size. (auth)

31182 DIFFERENTIAL CROSS SECTIONS FOR ELECTRON CAPTURE FROM ARGON BY 6-MeV PROTONS. Cocke, C.L.; Macdonald, J.R.; Curnutte, B.; Varghese, S.L.; Randall, R. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. Lett. 36: No. 14, 782-785 (5 Apr 1976).

Differential cross sections for the capture of electrons from argon by 6-MeV protons have been measured as a function of the hydrogen-atom scattering angle between 0.02° and 0.14°. Cross sections were measured for capture from all shells and from the argon *K* shell alone. The differential cross section for *K*-shell capture does not agree with theoretical results obtained using either the Oppenheimer-Brinkman-Kramers approximation or a Born calculation which includes a contribution from the core-core interaction. (auth)

31183 ULTRAVIOLET RADIATION PRODUCED IN NEAR-THRESHOLD Ar+Ar ATOMIC COLLISIONS. Rothwell, H.L. Jr.; Amme, R.C.; Van Zyl, B. (Department of Physics and Astronomy, University of Denver, Denver, Colorado 80210). Phys. Rev. Lett. 36: No. 14, 785-788 (5 Apr 1976).

First measurements are reported of the near-threshold behavior of the vacuum-ultraviolet emission cross section for Ar+Ar atomic collisions. The experimentally observed threshold is 18 ± 2 eV. The absolute emission cross section is presented for center-of-mass energies from threshold to 150 eV. The monitored radiation results from the decay of the lowest excited resonance state of the Ar atom and individual substate contributions are determined over most of the energy range investigated. (auth)

31184 POSSIBLE ROTATIONAL STATE EFFECTS IN He–HD TOTAL SCATTERING CROSS SECTIONS. Lang, N.C.; Kinsey, J.L. (Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Massachusetts 02138). J. Chem. Phys. 64: No. 6, 2536-2538 (15 Mar 1976).

Total scattering cross sections for ^{4}He–HD, D_2–^{4}He, and D_2–^{3}He are reported for relative velocities between 800 and 2400 m/s. The scattering of D_2–^{4}He and D_2–^{3}He can be described very well by the same isotropic potential. This potential however fails to predict the observed ^{4}He–HD cross sections. It is suggested that this may be evidence of the asymmetry of the He–HD interaction. (auth)

31185 STUDY OF EXCITATION TRANSFER IN A FLOWING HELIUM AFTERGLOW PUMPED WITH A TUNEABLE DYE LASER. III. TRANSFER AND QUENCHING REACTIONS OF THE $He_2(3p\ ^3\Pi)$ MOLECULE. Collins, C.B.; Johnson, B.W. (University of Texas at Dallas, Richardson, Texas 75080). J. Chem. Phys. 64: No. 6, 2605-2608 (15 Mar 1976).

The collisional transfer of excitation from the $He_2(3p\ ^3\Pi_g)$ state to other electronically excited states energetically lying within a few *KT* is examined by optically pumping a flowing helium afterglow with a tuneable dye laser. Rate coefficients for the transfer of excitation to states conserving spin, particularly $3d\ ^3\Pi_u$ and $3d\ ^3\Delta_u$, are found to be greater than 10^{-10} cm^3/sec, resulting in a rapid thermalization of

electronic and rotational energy. Relative probabilities of spontaneous radiation for transitions in the visible wavelength range from the product states are found to be 1 and 1/3 for the $3\Pi_u$ and $3\Delta_u$ states, respectively, relative to that from the initial $^3\Pi_g$ state. The absence of significant fluorescence from singlet states tends to confirm the conservation of spin during such reactions. (auth)

31186 ELECTRON EMISSION FROM METHANE, AMMONIA, MONOMETHYLAMINE, AND DIMETHYLAMINE BY 0.25 TO 2.0 MeV PROTONS. Lynch, D.J.; Toburen, L.H.; Wilson, W.E. (Battelle Northwest Laboratories, Richland, Washington 99352). J. Chem. Phys. 64: No. 6, 2616-2622 (15 Mar 1976).

Absolute cross sections, differential in electron energy and emission angle, have been measured for ejection of electrons from methane, ammonia, monomethylamine, and dimethylamine by 0.25 to 2.0 MeV protons. Electron energy distributions are presented for 12 emission angles between 15° and 125°. The results indicate that emission cross sections for electrons ejected with energy greater than about 1 eV show no effects related to molecular structure for this group of molecules, within experimental uncertainty. The double-differential cross sections are found to be scalable in terms of the number of weakly bound electrons per molecule. Total ionization cross sections are determined by integration of the double-differential cross sections with respect to energy and angle. The results are compared with the results for other low-Z polyatomic molecules, and also in the case of methane, with results from electron impact ionization. (auth)

31187 INELASTIC SCATTERING OF Ar^+ AND He^+ BY N_2 AT LOW keV ENERGIES. Fernandez, S. M. Storrs, CT; Univ. of Connecticut (1975). 107p. University Microfilms Order No. 76-1668.

Thesis (Ph. D.).

Doubly differential measurements are carried out on Ar^+ and He^+ ions scattered by N_2 at energies from 1.0 to 3.0 keV in an angular range from 0–4.0° (laboratory frame). Energy analysis of the scattered ions is performed electrostatically with a 5-inch parallel plate analyzer. The data are presented as energy-loss spectra at select scattering angles and incident projectile energies. In addition to elastic scattering our results reveal three types of inelastic processes, viz., vibro-rotational excitation of the ground state of N_2, electronic excitation of the target with concomitant vibro-rotational excitation, and ionization of the target. Study of the angular dependence of these processes suggest that (a) the collisions involve the entire molecule and are thus not adequately described in terms of a binary collision model, (b) electronic and vibrational excitation occur via mechanisms which exhibit negligible coupling, and (c) electronic excitation of N_2 is due predominantly to the B3 pi/sub g/ reverse arrow X1 SIGMA/ sub g/+ transition as evidenced by observation of the onset of dissociation of the B state at larger scattering angles. (Diss. Abstr., B)

31188 ABSOLUTE MEASUREMENT OF EXCITATION CROSS SECTIONS FOR THE 2P-STATES OF ATOMIC HYDROGEN IN CHARGE EXCHANGE COLLISIONS OF PROTONS IN ARGON AND NITROGEN. Suchannek, R. G. College, AK; Univ. of Alaska (1974). 328p. University Microfilms Order No. 75-26,194.

Thesis (Ph. D.).

Cross sections for the excitation of the 2P-states of atomic hydrogen in charge exchange collisions of protons in argon and nitrogen were measured by observing the Lyman-alpha radiation emitted in transitions from this state. For the measurement of the target gas pressure, a modified ionization gauge was developed, which eliminated distortions of pressure measurements due to charging effects on the glass envelope. Because of the lack of light standards in the vacuum ultraviolet region of the spectrum, the major problem of the measurements was the absolute calibration of the L/sub alpha/-photometer. This calibration was obtained from coincidence measurements of H/sub alpha/- and L/sub alpha/-photons in the presence of an electric field. The measurements were corrected for the effect of Doppler shift on photometer sensitivity. For the evaluation of the coincidence measurements, the branching ratio of H/sub alpha/-transitions to the 2S-state and the polarization of Lyman-alpha radiation, emitted in cascade processes, were needed. These quantities were obtained from quantum mechanical calculations of a hydrogen atom in a weak electric field. Cross sections for the 2P-states were obtained in the energy range from 0.5 to 30 keV. The 2P-cross sections in argon had maxima of 2.23×10^{-17} and 2.68×10^{-17} cm^2 at 3.35 and 11.86 keV, respectively, and in N_2 maxima of 2.17×10^{-17} and 2.10×10^{-17} cm^2 were observed at 3.39 and 11.3 keV, respectively. The energy dependence of the measured cross sections is in agreement with that of published measurements. Differences in the absolute values are discussed. (Diss. Abstr. Int., B)

31189 LOW ENERGY ELECTRON SCATTERING FROM ATOMIC OXYGEN AND OTHER NEUTRAL GASES. Dehmel, R. C. San Diego, CA; Univ. of California (1975). 126p. University Microfilms Order No. 75-29,435.

Thesis (Ph. D.).

The results of two experiments are reported on the scattering of low-energy electrons by neutral gases using the modulated crossed-beam technique. In the first experiment, measurements were made on the ratio of forward- to back-scattering of electrons in the energy range 3 to 20 eV by He, O, Ar, H_2, N_2 and O_2. It is found that atomic oxygen has an anomalously strong forward-scattering at the lower energies. Agreement is found between the present results for He, Ar, H_2 and N_2 and the ratios calculated from previously published differential cross-section measurements except for H_2 and N_2 at the lower energy limit. In the second experiment, measurements were made on the differential cross-sections for electrons scattered by He, O, Ar, and O_2 at 15 eV and by O and O_2 at 5 eV. The results for He, Ar, and O_2 agree well with previously published experimental and theoretical values. Measurements on O_2 extend to larger back-scattered angles than previously reported. Results for O are compared with the theoretical calculations of Thomas and Nesbet. Reasonable agreement with theory is obtained at 5 eV, and while the calculations only extend to 11 eV, the trend in shape appears correct. A small-angle dip in the cross-section is observed which is not predicted by the theory. The work concludes with a discussion of experimental problems and suggested improvements to the apparatus. (Diss. Abstr. Int., B)

31190 APPLICATION OF MANY BODY PERTURBATION THEORY TO THE CALCULATION OF ATOMIC PHOTOIONIZATION CROSS SECTIONS. Flifiet, A. W. Charlottesville, VA; Univ. of Virginia (1975). 76p. University Microfilms Order No. 76-20.

Thesis (Ph. D.).

The photoionization cross sections of ZnI and the 4d subshell cross section of BaI are calculated using many-body perturbation theory to include correlation effects. The 4s subshell cross section of ZnI is dominated by spin-orbit split autoionizing resonances, but other correlation effects are also important near threshold. A narrow absorption window is attributed to interference between resonances, and the diagrams which account for interference are identified. Qualitative agreement is obtained with the experimental data of Marr and Austin. The cross sections for 3d, 3p, and 3s electrons of ZnI are calculated up to 1000 eV, including intershell correlations. The 3d yields kf cross section calculated using the exact single channel random phase approximation with exchange is compared with a low order diagrammatic expansion. Autoionizing resonances due to the $3p^5ns$ and $3p^5nd$ configurations are included in the 3d yields kf cross section and the effect of core relaxation is considered. The 4d subshell cross section of BaI shows large correlation effects; however, a Hartree–Fock calculation is in qualitative agreement with the experimental data of Connerade and Mansfield, provided that an appropriate single-particle potential is used. The convergence of a low order perturbation expansion for the cross section is investigated. (Diss. Abstr. Int., B)

31191 SCATTERING OF SLOW PROTONS BY DIATOMIC TARGETS. Gianturco, F. A. (Univ., Pisa, Italy). Int. J. Quant. Chem.; 10: No. 1, 37-56(Jan 1976).

Inelastic collisions leading to rotationally excited molecular targets and involving protons as projectiles are theoretically examined from the point of view of both the scattering equations in the close coupling formalism and the interaction potentials between the partners. A phenomenological approach is suggested for constructing such interactions and computational results are reported for simple diatomic targets. The inadequacy of more traditional "static" approaches, when called for explaining dynamic couplings with open channels and centrifugal effects, is also discussed. 10 figures, 32 references. (auth)

31192 MOLECULE FORMATION IN TENUOUS MEDIA: QUANTUM EFFECTS IN SPONTANEOUS RADIATIVE ASSOCIATION. Ramaker, D. E. (George Washington Univ., Washington, DC); Peek, J. M. Phys. Rev., A; 13: No. 1, 58-64(Jan 1976).

The semiclassical theory for the spontaneous radiative association coefficient is reviewed. The example of H_2^+ formation during a proton collision with a hydrogen atom is considered in both the Kramers and Ter Haar and the Bates versions of the semiclassical theory. These two semiclassical predictions are identical for T greater than 50°K. Below this temperature range they differ and show the small-T limiting behavior expected from asymptotic considerations. The quantum theoretical rate coefficient for the same process is also evaluated. For 500 less than or equal to T less than or equal to 32,000°K, the quantum and semiclassical rates are in quantitative agreement. The quantum rate and the Bates version of the semiclassical rate show identical temperature dependence as T becomes small, $O(T^0)$, but their magnitudes differ for T less

than or equal to 500°K. The quantum rate always exceeds the Bates semiclassical rate in this temperature range, with the maximum difference being nearly an order of magnitude. This enhancement of the rate of molecule formation due to quantum effects is anticipated to be important in the context of the interstellar media.

31193 THEORETICAL STUDY OF AUTOIONIZING STATES AND LIFETIMES IN MULTIPLY EXCITED ARGON. Ong, W.; Russek, A. (Univ. of Connecticut, Storrs). Phys. Rev., A; 13: No. 1, 294-305(Jan 1976).

Autoionization transition rates have been calculated for a representative selection of spectroscopic terms of multiply excited argon atoms. The states selected consist of two highly excited electrons in the Rydberg states (n equals 4,5), together with one or two vacancies in the valence shell (n equals 3) and a single vacancy in the inner shell (n equals 2). Configuration mixing was found to be important. The eigenvalues and eigenstates were found by the truncated diagonalization method (i.e., QHQ is diagonalized). The effect of term splitting was included by calculating the contributions of the quadrupole terms in the interelectron repulsive potentials. The applicability of the msnp +- classification scheme suggested by Cooper, Fano, and Prats for helium was investigated for the outer electrons. Among the doubly excited outer-shell states found here are pairs of states which predominantly have the characteristics of 45sp + and 45sp - levels. However, states of the less-ionized system show less +- character because the shielding of the nucleus by the core electrons removes the degeneracy in energy of 4s5p and 5s4p levels, so there is less mixing when there is more shielding. The lifetimes of the valence-electron (n equals 3) shell decay range from approximately 10^{-15} to approximately 10^{-13} sec. The lifetimes of the highly excited electrons separate into two widely disparate ranges: from approximately 10^{-17} to approximately 10^{-16} sec and from approximately 10^{-13} to approximately 10^{-11} sec. The outer-shell states that have lifetimes shorter than the inner shell are those from which it is energetically possible for an electron to fall to a 4s, 4p, or 3d subshell, while the longer lifetimes are for states which can decay only to the n equals 3 core. (auth)

31194 DYNAMIC PROPERTIES OF ELECTRONICALLY EXCITED MOLECULES. Yardley, J. T. (Univ. of Illinois, Urbana). pp 231-279 of Chemical and Biochemical Applications of Lasers. Vol. 1. New York; Academic Press, Inc. (1974).

The phenomenon of electronic energy transfer in a molecular system is examined and the possibilities of lasers as an excitation source in experiments studying the different types of electronic energy transfer are investigated. Two broad types of processes are of interest: photophysical processes, involving no creation or destruction of chemical bonds, and photochemical processes, involving chemical reaction. A theoretical picture is drawn for the intramolecular energy transfer induced by external fields and for intramolecular processes in isolated molecules and those interacting with other molecules. Types of photofragment spectroscopy are examined, and the nature of predissociation in free molecules, collisional predissociation, and predissociation induced by external fields is studied. The use of lasers in the study of isomerization and rearrangement and for isotope separation is briefly considered. (IAA)

31195 USE OF INTERNAL CONVERSION X-RAYS FOR MEASUREMENT OF INNER SHELL PHOTOIONIZATION CROSS SECTIONS. Allawadhi, K. L.; Sood, B. S. (Punjabi Univ., Patiala, India). pp 290-292 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Department of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974).

K and L cross sections are measured at 36.818- and 74.409-keV photon energies for 17 elements in the range Z = 33 to 92. (JFP)

31196 POPULATING THE RESONANCE LEVELS OF ARGON DURING INELASTIC COLLISIONS OF METASTABLE ATOMS WITH SLOW ELECTRONS. Bochkova, O. P.; Sukiasyan, E. A. Zh. Prikl. Spektrosk.; 23: No. 4, 601-608(Oct 1975). (In Russian)

By optical and electrical methods a study was made of the afterglow from a positive, glow-discharge column of argon in the region of a change in pressure of 0.16 to 0.73 torr and discharge current strength of 0.5 to 30 ma. By means of electron concentrations measured in the afterglow and decay rates of atoms in the $3p^5 4s\,^3p_j$, $^1p_1$ states a determination was made of the rate constants for the transitions $^3p_2 \rightarrow {}^3p_1$ and $^3p_0 \rightarrow {}^1p_1$ during collisions of excited atoms with slow electrons, which were found to be $4 \pm 1 \times 10^{-7}$ cm^3/sec and $7 \pm 1.5 \times 10^{-7}$ cm^3/sec respectively for the above transitions. The diffusion coefficients of the metastable atoms in their own gas were found to be: $D(^3P_2)$ = 61 cm^2.sec^{-1}. torr and $D(^3P_0)$ = 56 cm^2.sec^{-1}. torr. 14 refs. (SJR)

Atomic Theory

Refer also to abstracts 28786, 31030, 31065, 31082, 31090, 31190, 31194, 31900, 31907, and 32033.

31197 SPECTRUM GENERATING GROUP OF THE SYMMETRIC TOP MOLECULE. Bohm, A.; Teese, R. B. (Univ. of Texas, Austin). J. Math. Phys. (N.Y.); 17: No. 1, 94-108 (Jan 1976).

The spectrum generating group for the symmetric top is found and applied to derive spectra, energy values and selection rules. All the well known results are reproduced, and some generalizations are obtained as a consequence of the group property, except for the Coriolis splitting for which an additional dependence upon the factor k/j is derived. (auth)

31198 ON THE LONG-RANGE CONFIGURATION INTERACTION BETWEEN IONIC AND COVALENT STATES. Janev, R.K. (Institute of Physics, Belgrade, Yugoslavia). J. Chem. Phys. 64: No. 5, 1891-1894 (1 Mar 1976).

The problem of long-range configuration interaction between ionic and covalent states is considered. The existing methods for calculation of this interaction are discussed. An asymptotically exact expression for the long-range configuration interaction at the crossing point of diabatic ionic and covalent potentials is derived. Using this expression the adiabatic energy splitting at the crossing point for $H^+ + H$, $M + H$, and $M + O$ systems (M = alkali atom) is calculated. The results are compared with those obtained by LCAO and variational calculations. (auth)

31199 KINETIC ENERGY IN THE STATISTICAL MODEL OF THE ATOM. Berrios-Pagan, I. N. New York; Fordham Univ. (1975). 165p. University Microfilms Order No. 76-4107.

Thesis (Ph. D.).

A correction factor is introduced in the Fermi kinetic energy in the Thomas–Fermi–Dirac–Weizsaecker model of the atom which becomes zero for one and two electron atoms. The energies are calculated following the Lenz and Jensen method with a trial density function which depends on two variational parameters. The energy is minimized with respect to the two parameters. Energy calculations are done for all neutral atoms from hydrogen to uranium, all ions with degree if ionization equal to one and two (up to uranium), helium isoelectronic series, neon isoelectronic series and argon isoelectronic series. The total radial density is computed for He, Ne, A, Kr, Xe and Hg. (Diss. Abstr. Int., B)

31200 DIRECT RELATIVISTIC FORMULATION OF CONSTANT MAGNETIC AND ELECTRIC FIELD EFFECTS IN SIMPLE ATOMS. 2. Moore, R. A. (Waterloo Univ., Ontario (Canada)). Can. J. Phys.; 53: No. 13, 1247-1250(1 Jul 1975).

A previously developed method of obtaining approximate solutions to the Dirac equation for the electron is applied to the problem of constant electric and magnetic effects in simple atoms. This method makes the relativistic formulation of these problems straightforward. In all cases the standard expressions are reproduced, as one would expect, and hence illustrates the simplicity and utility of the method. The Zeeman effect is calculated to order α^2, α being the usual fine structure constant, and it is seen that only the lowest order solutions are required. That is, one needs only the nonrelativistic solutions. The Stark effect and dipole transition matrix elements are calculated only to zero order in α as it is felt that that is all that is required for comparison with experiment. One concludes that the discrepancies between the theoretical values and experimental values of the oscillator strengths must be explained on the basis of nonrelativistic effects. (auth)

31201 DIRECT RELATIVISTIC FORMULATION OF THE HYPERFINE INTERACTION IN SIMPLE ATOMS. 3. Moore, R. A. (Waterloo Univ., Ontario (Canada)). Can. J. Phys.; 53: No. 13, 1251-1255(1 Jul 1975)

We apply a previously developed procedure for obtaining approximate solutions for the Dirac equation for the electron to the formulation of the hyperfine interaction in spherically symmetric atoms. Expressions are obtained to order α^2, α being the usual fine structure constant. The hydrogen 1S state is solved and seen to be correct to order α^2. This result is taken to be a positive test of the procedure. Further, one sees that the first order equations are solvable, the form of the solutions, and that all the required contributions are finite. Also, in terms of numerical work the time required will not be appreciably greater than needed for a nonrelativistic calculation. This leads to the conclusion that one has a practical and valid method of solving relativistic problems to order α^2. (auth)

31202 RELATIVISTIC CALCULATION OF THE PROBABILITY OF INTERCOMBINATIONAL TRANSITIONS. Gurchumeliya,

A. D.; Labsovskii, L. N.; Safronova, U. I. (Leningrad State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 90-96(1975). (In Russian).

On the basis of the S-matrix theory, expressions were obtained for the calculation of the probability of electric multipole transitions in the relativistic approximation in the first order of field perturbation theory. Corrections corresponding to the simultaneous consideration of the external field and the interelectron interactions are also examined. Results are reported for the calculation of the wave length and the probability of intercombinational transitions in multicharged ions between the $1s\,2p-1s^2$ configurations at $4 \leq Z \leq 28$ and $1s^2\,2s^{n_1}\,2p^{n_2} - 1s^2\,2s^{n_2\pm1}\,2p^{n_2\pm1}$ at $20 \leq Z \leq 30$. The data obtained can be used for interpretation of the soft x radiation arising during transitions observed in the solar corona and high temperature plasma laboratories. (tr-auth)

31203 INTERPOLATED VALUES OF $|\psi_{ns}(0)|^2$. Saitov, R.K.; Trifonov, E.D.; Shendrik, A.V.; Yudin, D.M. Opt. Spectrosc. (USSR) 39: No. 5, 461-463 (Nov 1975).

By an interpolation method $|\psi_{ns}(0)|^2$ are calculated for free atoms ($1 \leq Z \leq 105$). Possibilities of changing the interpolation formula for inner and outer *s* electrons of ions and excited states of atoms are discussed. An improved variation of the $|\psi_{ns}(0)|^2$ calculation which treats the dependence of the screening coefficients of valence electrons on the number of electrons in a given shell is proposed. The results of the calculations are tabulated. A comparison with Hartree-Fock values of $|\psi_{ns}(0)|^2$ is made. (auth)

31204 EFFECT OF A STRONG PULSED MAGNETIC FIELD ON THE GROUND STATE OF ATOMS WITH HYPERFINE STRUCTURE. Skrotskii, G.V.; Solomakho, G.I. Opt. Spectrosc. (USSR) 39: No. 5, 470-473 (Nov 1975).

The effect of a pulsed magnetic field on the polarization of atoms in the ground state is investigated theoretically. It is shown that breaking the hyperfine coupling under the influence of a strong pulsed magnetic field may be used to obtain hyperfine states and also to induce the transfer of various kinds of coherence (orientation, alignment) between levels of the hyperfine structure. (auth)

31205 INFLUENCE OF POLARIZATION EFFECTS ON THE EXCHANGE INTERACTION OF ATOMS. Ivanov, G.K. Opt. Spectrosc. (USSR) 39: No. 5, 474-476 (Nov 1975).

The exchange interaction U_{exc} of an excited atom A^* or negative ion A^- with an atom is analyzed with the aid of an asymptotically exact expression for the level shift of a loosely bound electron. It is shown that when the polarization effects are taken into account, the coefficient of proportionality of U_{exc} to the square of the electronic wave function at the point where the perturbing atom is located differs in structure from the observed amplitude of scattering by the atom, but is expressed in terms of the same parameters (scattering length, polarizability of the atom). In particular, in the π state, U_{exc} is determined, not by the leading term linear in the electron momentum in the expansion of the amplitude of *p* scattering (as is usually assumed), but by the succeeding terms. (auth)

31206 RELATIONSHIP BETWEEN THE RAYLEIGH–SCHROEDINGER AND ASYMPTOTIC PERTURBATION THEORIES OF INTERMOLECULAR FORCES. Whitton, W. N.; Brown, W. B. (Univ. of Manchester, Eng.). Int. J. Quant. Chem.; 10: No. 1, 71-86(Jan 1976).

The relation of the straightforward Rayleigh–Schroedinger perturbation theory for the interaction of two atoms to the asymptotic exchange theory is described. The one-electron case of a hydrogen atom perturbed by a nucleus is examined in detail. It is shown that the asymptotic theory contains an infinite summation of terms in the Rayleigh–Schroedinger series. The nature of the branching between states and its implications for convergence is elucidated. (auth)

31207 INFLUENCE OF THE STRUCTURE OF VARIOUS FUNCTIONS ON THE EVALUATION OF THE CORRELATION ENERGY. Pellegatti, A.; Julg, A. (Universite de Provence, Marseille). Int. J. Quant. Chem.; 10: No. 1, 113-121(Jan 1976). (In French).

The influence of various correlation functions, multiplying the monoelectronic space function, is studied and applied to the helium atom and its isoelectronic series. We used Slater-type basis orbitals and the ground and first excited states have been studied, taking into account the virial and cusp conditions. In the ground state, a very good value for the correlation energy is obtained, using a function of the type: 1 - (1/1 + 2alpha) e/sup -alpha r_{12}/. For the excited states, this type of function overestimates the assumed value of the correlation energy. (auth)

31208 CONVERGENCE BEHAVIOR OF SOME MULTICONFIGURATION METHODS. Banerjee, A.; Grein, F. (Univ. of New Brunswick, Fredericton). Int. J. Quant. Chem.; 10: No. 1, 123-134(Jan 1976).

The optimization scheme of the "multiconfiguration method based on the generalized Brillouin theorem" (MCGBT) has been analyzed and found to converge quadratically. Its rate of convergence has been compared with that of other optimization methods such as the first-order Rayleigh–Schroedinger perturbation, the steepest descent, the single vector diagonalization, the Newton–Raphson, and the conventional SCF method. The convergence of the MCGBT scheme has been found to be superior to the convergence of the above mentioned schemes. (auth)

31209 DIRECT MINIMIZATION OF THE ENERGY BY SIMULTANEOUS VARIATION OF PARAMETERS IN NONORTHOGONAL BASIS FUNCTIONS. I. Method. Weltin, E. E. (Univ. of Vermont, Burlington). Int. J. Quant. Chem.; 10: No. 1, 163-174 (Jan 1976).

A direct method to optimize parameters in nonorthogonal basis orbitals is discussed. The partial derivatives of the energy of the state of interest, not necessarily the ground state, with respect to the orbital parameters are calculated analytically. The required cofactors up to third order of the overlap matrices over spin-space orbitals in pairs of Slater determinants are calculated by biorthogonalization. All parameters are varied simultaneously in the direction of the negative gradient (steepest descent). A search logic with dynamically adjusted step-size is shown, in the example of the minimum basis Ne ground state, to find the energy minimum in an efficient manner. (auth)

31210 MODIFIED POTENTIALS IN MANY-BODY PERTURBATION THEORY. Silver, D. M. (Johns Hopkins Univ., Laurel, MD); Bartlett, R. J. Phys. Rev., A; 13: No. 1, 1-12(Jan 1976).

Many-body perturbation-theory calculations of the pair-correlation energy within the regime of various finite expansions in two-center Slater-type basis sets are performed using a wide variety of modified potentials for the determination of unoccupied orbitals. To achieve meaningful convergence, it appears that the perturbation series must be carried through third order, using shifted denominators to include contributions from various higher-order diagrams. Moreover, certain denominator shifts are found necessary to ensure that a negative-definite resolvent accompanies the perturbation scheme when an arbitrary modified potential is employed. Through third order with denominator shifts, well-behaved modified potentials are found to give results that are equivalent, within 1 kcal/mole, to those obtained for pair-correlation energies with the standard self-consistent-field-V/sup N/ potential. (auth)

31211 VARIATIONAL BETHE–GOLDSTONE CALCULATIONS OF ATOMIC OSCILLATOR STRENGTHS. Be Sequence. Moser, C. M. (Paris Univ., Orsay, France); Nesbet, R. K.; Gupta, M. N. Phys. Rev., A; 13: No. 1, 17-22(Jan 1976).

Atomic oscillator strengths have been computed by applying a Bethe–Goldstone hierarchy of variational calculations consistently to both initial and final states of a given transition. For the $1s^2\,{}^1S$ yields $1s2p\,{}^1p/sup\ o/$ transitions in the He isoelectronic sequence, computed f/sub 1/ (length) and f/sub v/ (velocity) values and the corresponding transition energies are in good agreement with the accurate f values of Pekeris et al, and with observed transition energies. For the Be isoelectronic sequence, f/sub 1/ and f/sub v/ for $1s^22s^2\,{}^1S$ yields $1s^22s2p\,{}^1P/sup\ o/$ are in close agreement with each other if all double virtual excitations from 1s2s2p (with respect to $1s^22s2p$ as reference configuration) are included in the variational calculations. The agreement between computed and observed transition energies is very good. Similar results have been obtained for other valence shell excitations of BeI: $2s2p\,{}^3P/sup\ o/$ yields $2p^2\,{}^3P$, $2s2p\,{}^1P/sup\ o/$ yields $2p^2\,{}^1D$, $2s2p\,{}^1P/sup\ o/$ yields $2p^2\,{}^1S$. The $2p^2\,{}^1S$ state apparently lies slightly above the Be II 2s threshold. The $2p^2\,{}^1D$ state interacts strongly with the $2s3d\,{}^1D$ Rydberg state. The oscillator strength is nearly zero for the $^1P/sup\ o/$ yields ^1D transition. (auth)

31212 Z^{-1}-EXPANSION CALCULATION OF TWO-PARTICLE CORRELATIONS IN ATOMS. Ruffa, A. R. (Naval Research Lab., Washington, DC). Phys. Rev., A; 13: No. 1, 27-42(Jan 1976).

A calculation of the expectation value of the mass-polarization operator [vector p_1·vector p_2] for the two-electron atom is made using the Z^{-1} perturbation expansion in order to determine the usefulness of this approach in calculating two-particle correlations in atoms. Evaluation of the first-order contribution to [vector p_1·vector p_2] yields a value in good agreement both with an earlier value determined by another method and with the value which may be deduced from calculations using very accurate wave functions. An interesting feature of the calculation is the finding that the summations are dominated by contributions from matrix elements which involve continuum states, with more than 85 percent of the

total coming from these contributions. The second-order contribution is then obtained by demonstrating that both first- and second-order contributions are included in the first-order formula if accurate uncorrelated wave functions for the ground state are used in the matrix elements, rather than the bare hydrogenic orbitals. After observing that most of the greater accuracy of such wave functions arises from inclusion of electronic screening, the first-order calculation is repeated using simple screened hydrogenic orbitals in the matrix elements. The values of [vector p_1·vector p_2] obtained by means of this simple calculation for various Z values agree quite well with those calculated by Hart and Herzberg using accurate 20-term wave functions. The conclusion which is drawn from this calculation is that this method appears to be relatively simple and quite promising for calculating certain types of correlation effects, such as those resulting from double excitation or ionization of valence or inner-shell electrons. As examples of this, qualitative estimates are made of the behavior of the double photoionization cross sections of the remainder of the He isoelectronic sequence (Z greater than or equal to 3) and of other closed-shell atoms. (auth)

31213 MANY-BODY THEORY OF ATOMIC TRANSITIONS. Chang, T. N.; Fano, U. (Univ. of Chicago). Phys. Rev., A; 13: No. 1, 263-281(Jan 1976).

Hartree–Fock equations for transition matrices are formulated as an extension of the ordinary theory of atomic spectra. These equations form a hierarchy which may be subjected to various truncations. Some of the truncations are identified as equivalent to different forms of many-body theories (random-phase approximation, time-dependent Hartree–Fock, many-body perturbation theory, etc.). Thereby we connect the modern many-body treatments more explicitly with the Condon–Shortley–Racah tradition of spectra theory and provide physical interpretations of various approximations. Spin and angular variables are factored out at the outset by angular-momentum techniques. The problem then takes the form of a system of integro-differential equations for radial wave functions, which affords conceptual and computational advantages. The correlations that are characteristically studied by many-body techniques are seen to be confined to short radial distances and could accordingly be treated by R-matrix procedures. (auth)

31214 TRANSITION MATRICES FOR THE THEORY OF SPECTRA. Techniques for Their Construction and Calculation. Chang, T. N.; Fano, U. (Univ. of Chicago). Phys. Rev., A; 13: No. 1, 282-293(Jan 1976).

Analytical techniques are developed for constructing nth-order (i.e., n-electron) tensor matrices pertaining to transition of an N-electron atom between two of its stationary states. These matrices serve to calculate the transition amplitude for the atom under the influence of an external field acting on n electrons (typically n equals 1). Their calculation requires, in turn, the solution of a truncated hierarchy of Schroedinger equations introduced in the preceding paper. The techniques presented here are applied to construct the matrices and their Schroedinger equation for the example of Ar atoms treated in the preceding paper. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstracts 31219, 31224 and 32065.

31215 MICROSCOPIC THEORY OF He II-He^3 MIXTURES INCLUDING DISSIPATIVE PROCESSES. Pt. 1. Derivation of Hydrodynamic Equations. Szprynger, A. (Polska Akademia Nauk, Wroclaw. Instytut Niskich Temperatur i Badan Strukturalnych). Z. Phys., B; 22: No. 1, 79-83(1975).

On the basis of the microscopic theory proposed by Bogoliubov the hydrodynamic equations with the dissipative terms for He II-He^3 solutions are derived. Ten kinetic coefficients connected with external fields are introduced. (DE)

31216 MICROSCOPIC THEORY OF He II-He^3 MIXTURES INCLUDING DISSIPATIVE PROCESSES. Pt. 2. Solutions of Linearized Hydrodynamic Equations. Szprynger, A. (Polska Akademia Nauk, Wroclaw. Instytut Niskich Temperatur i Badan Strukturalnych). Z. Phys., B; 22: No. 1, 85-92(1975).

The conclusions following from the solutions of the linearized hydrodynamic equations are discussed. By using some symmetry properties of the Green functions the kinetic coefficients coupled to the external fields are determined and some interesting information concerning the thermodynamic derivatives of the condensate density arises. A number of the Green functions are calculated in the hydrodynamic approximation. The examination of their denominators leads to the expressions for damping of the acoustic modes in He II-He^3. A set of Kubo-type formulae for the kinetic coefficients and certain sum rules are obtained. (DE)

31217 DOMAIN TO TWO-DIMENSIONAL EXCITATIONS IN THIN LIQUID HELIUM FILMS. Washburn, T. E. Urbana, IL; Univ. of Illinois (1975). 91p. University Microfilms Order No. 76-7005.

Thesis (Ph. D.).

The velocity of third sound has been measured in the temperature range 0.1–1.5 K for pure ^{4}He films ranging in thickness from 1.77 to 6.58 atomic layers. The films were adsorbed on an argon substrate inside a quartz cell which served as a resonator for the velocity measurements and a pressure sensor in the measurement of film thickness. The oscillator strengths and the Q's of the resonances were also measured. A simple description of our measurements was found within the framework of the Landau quasiparticle theory. For films thinner than 3 atomic layers this interpretation yields an areal excitation density which is independent of film thickness and which has a T^3 temperature dependence. Using these measurements and a Landau theory calculation, the velocity of these phonon-like excitations was found to be 76 ± 2 m/sec. Both the liquid-vapor interface and the liquid-substrate interface have been considered by others as possible sources of excitations. Although each should give two-dimensional excitations, the predicted temperature dependence of the density does not agree with the observed T^3 dependence. The temperature dependence of the Q's of the resonances may be explained by two-fluid hydrodynamics but a strong drop in the oscillator strength at low temperatures remains unexplained. (Diss. Abstr. Int., B)

31218 APPLICATION OF THE RAY METHOD TO THE STATIONARY EQUATIONS OF ELECTRODYNAMICS IN A CONDUCTING LIQUID. Semenov, V.S. (A. A. Zhdanov Leningrad State University). Sov. Phys.—Tech. Phys. 20: No. 8, 1013-1016 (Aug 1975).

The well-known ray method, used in optics, is applied to the stationary two-dimensional MHD equations in the kinematic approximation. This approach is possible because in both cases the equations belong to the class of singular perturbation equations. The basic equations of the ray method are derived and a ray system of coordinates is constructed. It is shown that the magnetic lines of force in the zeroth approximation behave in a similar way to the wavefronts in optics. The law of refraction for the lines is derived. The fundamental solution is obtained for the case of the nonuniform flow of a conducting liquid. The results are compared with the well-known solution for a uniform flow. (auth)

31219 STEADY MHD AND EHD FLOWS OF NON-NEWTONIAN FLUIDS. Martinson, L. K. Magn. Gidrodin.; No. 3, 21-28 (1975). (In Russian)

Steady gradient and displacing MHD and EHD flows of non-Newtonian fluids in flat channels, flowing with the rheological law proposed by V. V. Novozhilov, were examined. The solutions of the problem on the distribution of the fluid velocity in the channels were reduced to a quadrature. The effect of different parameters of the problem on the character of the flow was analyzed. The limiting processes to the flow of Newtonian fluids and to MHD flow were examined. (tr-auth)

31220 STEADY MHD FLOW, ASSOCIATED WITH WAVE PROPAGATION, IN CLOSED CIRCULAR TUBES. Antimirov, M. Ya. Magn. Gidrodin.; No. 3, 53-57(1975). (In Russian)

The flow of a conducting fluid in circular tubes with non-conducting walls was studied. The face of the tube was closed by a film transparent to waves. A circular beam of waves whose radius is less than the tube radius directly impinges on one of the faces. This beam causes near the tube axis a flow in the direction of the axis, but near the tube walls a flow in the opposite direction because of the closure of the flow. The solution of the system of equations describing this problem was obtained in the form of a series with Bessel functions. Asymptotic representations of the solution were obtained for small and large Hartman numbers. (tr-auth)

31221 MHD WAVE TRANSFORMATION AT THE PLASMA–VACUUM BOUNDARY. Pavlov, V. A. Magn. Gidrodin.; No. 3, 58-62(1975). (In Russian)

The transmission of MHD waves, excited by a moving point pulse source, through the boundary separating the homogeneous anisotropic cold plasma and the homogeneous isotropic medium is examined. The plasma is described by a linear system of MHD equations. Approximate expressions were obtained and analyzed for a magnetic field in isotropic medium. The ratio of the rate of movement of the pulse source and the Alfven velocity was considered a small parameter of the problem. (tr-auth)

31222 GENERATION OF ACOUSTIC WAVES BY ALFVEN WAVES AT THE DIFFUSION BOUNDARY WITH NON-IONIZED MEDIUM. Covchenko, Yu. N.; Gorbachev, L. P. Magn. Gidrodin.; No. 3, 63-68(1975). (In Russian)

Two media were examined: an ionized and partially ionized cold plasma separated by a layer formed as a result of the diffusion of charged particles into the non-ionized region. The media were assumed to be homogeneous in the horizontal direction and non-homogeneous along the direction of acceleration of free fall. The excitation of acoustic waves by Alfven waves at small angles of inclination of the external magnetic field to the vertical. The medium was examined as a three-component gas consisting of ions, electrons, and neutral particles. The frequencies studied were much larger than the frequency of collision of the neutral particles with charged particles much less than the gyrofrequency of the ions. There was pressure in the acoustic waves generated by the Alfven waves in the diffusion layer which had a gyrotropic conductivity. The generation coefficient of the acoustic waves was introduced and their behavior was studied as a function of the wave frequency and the medium parameters. It was shown that the most intense bonding of the waves occurred at low frequencies. The presence of a local extremum was observed in the behavior of the generation coefficient, explainable by the appearance of a resonance property of the region of the greatest generation of acoustic waves. (tr-auth)

31223 QUASI-LINEAR THEORY OF HYDRODYNAMIC TURBULENCE AND INSTABILITY OF PLANE-PARALLEL PLASMA FLOW. Aref'ev, V. I. Magn. Gidrodin.; No. 3, 69-74(1975). (In Russian)

Studies were made on the stability of plane-parallel flow of a conducting fluid between two parallel plates. A method was proposed for determining the approximate eigenvalues of the boundary problem which makes it possible to find the limit of unstable oscillation in the quasi-linear approximation when the flow profile becomes a stable turbulent flow from the non-stable laminar flow as a result of the establishment of a quasi-equilibrium level of turbulence. An equation determining the boundary of stability describes the profile of the turbulent flow being established. The velocity profile and the magnetic field profile of the turbulent MHD flow was studied in the quasi-linear approximation. The characteristic effect of the stratification of flow, observed experimentally, was established. (tr-auth)

31224 CALCULATION OF THE AXIAL-SYMMETRIC FLOW OF A NON-EQUILIBRIUM IONIZED GAS IN ELECTRICAL AND MAGNETIC FIELDS. Fursenko, A. A.; Shmidt, A. A. Magn. Gidrodin.; No. 3, 149-150(1975). (In Russian)

An iteration method is proposed for the solution of the boundary problem arising during axial-symmetric flow of a conducting gas in a coaxial channel in a radial magnetic field and an axial electrical field. (tr-auth)

31225 UNIVERSE STABILITY IN HYDROMAGNETICS. Chidananda, S. V.; Jain, R. K. J. Math. Phys. Sci.; 8: No. 4, 354-355, 362 (1974).

Universal stability of an incompressible finitely conducting viscous fluid is restudied by the method of Serrin. Using a symmetric form of the basic equations the stability analysis of the hydromagnetic problem is reduced to the hydrodynamic one and further the sublinear instability is eliminated whenever the magnetic field H_i is uniform or the matrix (H_i, j) is symmetric. (10 ref) (Ind. Sci. Abstr.)

PHYSICS (HIGH-ENERGY)

31226 (MPI-PAE-Exp.El.-42) ANNUAL REPORT 1974 OF THE PHYSICS INSTITUTE. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F.R. Germany)). Dec 1974. 112p. (In German). INIS.

With figs. and refs. Available from ZAED.

The main activities of the single departments are: K^+d interactions at 4.6 GeV/c; $K^-p \to \Sigma^+\pi^-$ with the hyperon bubble chamber; $\bar{K}N$ reactions at low energies; pp reactions at 12.24 GeV/c; streamer chamber experiment CERN (ISR); experiments with DESY (DORIS); data processing and evaluation. $\pi\pi$ interaction and ρ,f,g resonance; $\pi^-p \to \bar{p}pn$ at 9.8, 18.8 GeV; $\pi^-p \to K^+K^-n$ at 18.4 GeV; A_2 resonance; quark search at CERN (ISR); $\pi^-p \to \pi^+\pi^-n$ on a transversal polarized butanol target at 17 GeV. Theoretical elementary particle physics: field theory (non-linear spinor theory, Wightman theories, renormalization, gauge theory, Lepton hadron symmetry, QED and weak interaction); phenomenology of the particles (particle production with pp, ope and $\pi\pi$ scattering, diffractive photon induced processes, multiple production and increasing total cross sections, weak interaction and neutral currents) and multiparticle physics. Furthermore, the report contains a personnel survey and indications about publications, seminars, lectures, diplomas and promotions. (DE)

Particle Interactions and Properties (Experimental)

Refer also to abstract 31372.

31227 RESULTS OF THE TORINO SEARCH FOR QUARKS. Briatore, L. (CNR, Turin); Dardo, M.; D'Ettorre Piazzoli, B.; Mannocchi, G.; Picchi, P.; Visentin, R.; Sitte, K. Nuovo Cim., 31A: No. 4, 553-567(21 Feb 1976).

After a brief review of previous experiments which have indicated the presence of "quark condidates" among the shower particles detected at 40 m w.e. underground, the results of a further search with two spark chamber telescopes are reported. Small pulses in the top scintillators of the triggering arrangement and delayed arrivals with respect to the shower front were used as initial "quark signature". Interactions originated by the traversing particles in five layers of 5 cm Pb plus 1.8 cm Fe could serve as an additional criterion to establish the nature of the particles. The visualizing technique allowed rigorous elimination of all spurious effects resulting from soft accompaniment which could have contributed in the earlier measurements. Although also the final runs showed an unexplained excess of delayed small-pulse events corresponding to a "flux" of about 1×10^{-9} particles/cm^{2}s sr, the observations are not considered as convincing evidence for the existence of quarks. The interaction characteristics of the delayed particles are indistinguishable, within the statistical uncertainties, from those of the shower muons. (auth)

31228 OBSERVATION OF THE DECAY $\psi(3684) \to \psi(3095)\,\eta$ Tanenbaum, W.; Abrams, G.S.; Boyarski, A.M.; Breidenbach, M.; Bulos, F.; Chinowsky, W.; Feldman, G.J.; Friedberg, C.E.; Fryberger, D.; Goldhaber, G.; Hanson, G.; Hartill, D.L.; Jean-Marie, B.; Kadyk, J.A.; Larsen, R.R.; Litke, A.M.; Lüke, D.; Lulu, B.A.; Lüth, V.; Lynch, H.L.; Morehouse, C.C.; Paterson, J.M.; Perl, M.L.; Pierre, F.M.; Pun, T.P.; Rapidis, P.; Richter, B.; Sadoulet, B.; Schwitters, R.F.; Trilling, G.H.; Vannucci, F.; Whitaker, J.S.; Winkelmann, F.C.; Wiss, J.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 36: No. 8, 402-405 (23 Feb 1976).

We have observed the decay $\psi(3684) \to \psi(3095)\,\eta$ with a branching fraction of (4.3±0.8) %. This measurement, together with previous measurements of $\psi(3684) \to \psi(3095)$ + anything, $\psi(3684) \to \psi(3095)\,\pi^+\pi^-$, and $\psi(3684) \to \psi(3095)\,\gamma\gamma$, indicates that isospin is conserved in the decay $\psi(3684) \to \psi(3095)\,\pi\pi$ and establishes the isospin and G parity of the $\psi(3684)$ to be $I^G = 0^-$. (auth)

31229 INSTITUTE OF HIGH ENERGY PHYSICS OF THE ACADEMY OF SCIENCES OF THE GDR. Lanius, K. (Joint Inst. for Nuclear Research, Dubna (USSR)). Kernenergie; 18: No. 7, 207-214(1975). (In German)

A brief review is given of the history of evolution, the most important recent and future research problems of, as well as some essential results from the Institute of High Energy Physics of the Academy of Sciences of the GDR in Zeuthen. (GC)

31230 DAS ATOM—FORSCHUNG UND NUTZUNG. (The Atom—Its Exploration and Uses). Petros'yants, A. M. Berlin; Akademie-Verlag (1973). 358p. (In German)

This excellent book, written clearly and easy to follow, presents a survey of the development of nuclear research and nuclear technology in the Soviet Union. The author deals with important fields of nuclear energy and its peaceful uses: high-energy physics and accelerators; thermonuclear fusion; nuclear power plants for electric power generation, desalination of seawater, and ship propulsion; perspectives of fast breeder reactors; uranium resources; environmental aspects of nuclear energy; uses of radioisotopes and ionizing radiation in science, industry, agriculture, and medicine; and radioactive waste disposal. In addition, a complete survey of Soviet Union's institutes and centers in the field of nuclear research and technology is given. (GC)

Electromagnetic

31231 INVESTIGATION OF THE INCLUSIVE DISTRIBUTION OF γ QUANTA FORMED IN π-p INTERACTIONS AT 5 GeV/c. Amaglobeli, N. S.; Budagov, Yu. A.; Binogradov, V. B.; Dzhelepov, V. P.; Dubinskii, Yu. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 6, 1269-1272(Dec 1975). (In Russian).

Experimental results on the inclusive distribution of γ quanta, which are shown graphically, led to the following conclusions. The one-particle inclusive distribution for π-p $\to \gamma + \ldots$, integrated with respect to p_T^2, does not depend on the energy in the central region in the interval from 5 to 100 GeV and in the region of target fragmentation and π^- mesons in the interval from 5 to 40 MeV. This indicates that the formation of γ quanta in π^-p interactions shows a limiting behavior even at 5 GeV. (JSR)

31232 PHOTOPRODUCTION OF RHO^0 AND RHO$^-$ MESONS IN GAMMA-DEUTERIUM INTERACTIONS. Bapu, P. T. Cincinnati; Univ. of Cincinnati (1975). 96p. University Microfilms Order No. 76-5955.

Thesis (Ph. D.).

Photoproduction of ρ^0 s on deuterons and neutrons and ρ^-s on neutrons are studied by analyzing 150,000 pictures taken at the SLAC deuterium filled bubble chamber, using a 3 GeV linearly polarized photon beam. The cross sections for different topologies and the reactions $\gamma d \to p_s p\pi^-\pi^0$, $\gamma d \to p_s n\pi^+\pi^-$ and $\gamma d \to d\pi^+\pi^-$ agree with previous experiments. For ρ^0s, the decay angular distributions and density matrix elements in the helicity system indicate s-channel helicity conservation and natural parity exchange dominating the t-channel. For ρ^-s, the nine density matrix elements are determined in G-J and helicity frames; the matrix elements in G-J system for unnatural parity exchange are found to be consistent with OPE. Separating the cross section into the contributions due to natural (σ^n) and the unnatural (σ^u) parity exchanges, we found that the production of ρ^- proceeds via approximately equal amounts of OPE and OVE. From σ^u, the $\pi\rho\gamma$ width is calculated by comparing it with the σ^u of $\gamma p \to \omega p$ to be 0.19 ± 0.06 MeV. The differential cross section, $d\sigma/d\Omega$, is checked against Clark's OVE predictions. Values for rho quadrupole moment greater than zero and magnetic dipole moment less than a few times the value of .93 μN fail to explain the experimental data as well as the ρ^- cross section in the context of Clark's gauge invariant model. (Diss. Abstr. Int., B)

31233 NEUTRON FINAL STATES IN DEEP INELASTIC ELECTRON SCATTERING. Francis, W. R. Ithaca, NY; Cornell Univ. (1975). 222p. University Microfilms Order No. 76-5937.

Thesis (Ph. D.).

A study of the inclusive process $e + p \to e + n + X^+$ was performed at the Cornell University 12 GeV electron synchrotron. An extracted electron beam was directed onto a 0.5 inch liquid hydrogen target. Scattering electrons were momentum analyzed in a conventional wire spark chamber-magnet spectrometer. Recoil neutrons and protons were detected, in coincidence, in a scintillation counter hodoscope, time-of-flight spectrometer. The scattering was interpreted as a virtual photoproduction process. The virtual photon kinematics spanned the range $0.3 < Q^2(\mathrm{GeV/c})^2 < 1.5$ and $2.0 < \nu(\mathrm{GeV}) < 6.0$. The neutron inclusive cross section, $d\sigma/dm^2dtd\phi$, is reported for $0.0 < m^2 - (\mathrm{GeV}^2) < 1.5$, $0.2 < t(\mathrm{GeV/c})^2 < 0.8$, and $170° < \phi < 190°$. Comparison is made with the proton inclusive yields measured in the same apparatus. (Diss. Abstr. Int., B)

31234 TEST OF QUANTUM ELECTRODYNAMICS BY A STUDY OF THE REACTION $e^+e^- \to \mu^+\mu^-$ AT THE CENTER OF MASS ENERGY OF 5.2 GeV. Martin, T. W. Stanford, CA; Stanford Univ. (1975). 193p. University Microfilms Order No. 76-5767.

Thesis (Ph. D.)

A study of the time-like reaction $e^+e^- \rightarrow \mu^+\mu^-$ at angles close to 90°, relative to Bhabha scattering at 3.7°, was made at a center of mass energy equal to 5.2 GeV. The experiment was conducted at the SLAC colliding beams facility and the muon pairs were detected and identified through time of flight and reconstructed trajectory information. The results were found to be in good agreement with Quantum Electrodynamics, within an experimental error of 16%. (Diss. Abstr. Inst., B)

31235 PROCEEDINGS OF THE 1975 INTERNATIONAL SYMPOSIUM ON LEPTON AND PHOTON INTERACTIONS AT HIGH ENERGIES, STANFORD, CALIFORNIA, AUGUST 21–27, 1975. Kirk, W. T. (ed.). Stanford, CA; Stanford University (1975). 1077p. (CONF-750855–).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

Separate abstracts were prepared for the 41 papers presented. (JFP)

For abstracts of individual papers see: 31236–31244, 31256–31264, 31294, 31322–31330, 31364, 31365, 31411–31415, 31460–31463, 31521, and 32049.

31236 HADRON PRODUCTION AT SPEAR. Schwitters, R. F. (Stanford Univ., CA). pp 5-24 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

A report is given of the knowledge obtained from SPEAR about hadron production in e^+e^- annihilation since the discovery of the new particles. Included are the SPEAR magnetic detector, the total cross sections, mean charged multiplicity and energy, inclusive momentum spectra, and hadron angular distribution. (JFP)

31237 DORIS RESULTS FROM THE DESY HEIDELBERG COLLABORATION. Heintze, J. (Univ., Heidelberg). pp 97-112 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

Inclusive photon spectra and photon spectra for events with 4 prongs and 1 gamma-ray which result from the decay of the (3.1) and (3.7) resonances are presented. The decay (3.7) yields 3.1 + gamma gamma is observed, confirming earlier results of the DASP collaboration. In an investigation of 3 gamma final states, the decay modes (3.1) yields eta gamma and (3.1) yields eta' gamma are detected. In addition, the data indicate the existence of a new heavy mass particle at approximately 2.75 GeV which decays into two photons. This conclusion is based on an analysis of the 3 gamma events from (3.1) decays, combining results from the DASP and the DESY-Heidelberg collaborations. (auth)

31238 THEORY OF ELECTRON–POSITRON ANNIHILATION INTO HADRONS. Gilman, F. J. (Stanford Univ., CA). pp 131-154 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The discussion covers the total cross sections for e^+e^- yields hadrons and R, its ratio to the muon pair cross section, physics above and below the threshold near 4 GeV cms with particular attention to the changes and where they take place, and inclusive distributions and final-state hadrons. (JFP)

31239 PHOTOPRODUCTION OF NEW PARTICLES AT FERMILAB. Lee, W. (Columbia Univ., New York). pp 213-239 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

A review is given of recent results of a photoproduction experiment. The discussion includes the beam itself and experimental results from which it is concluded that the photoproduction of psi(3100) and psi(3700) were observed, the psi(3100) is photoproduced diffractively on the Be nucleus, and sigma(PSI N) approximately 1.0 mb if one assumes vector dominance and that the forward scattering amplitude is purely imaginary. A search for new particles is also discussed, but more events are needed before definite conclusions can be drawn. (JFP)

31240 PRODUCTION OF NEW PARTICLES WITH PHOTONS AND ENERGY BELOW 12 GeV. Gittelman, B. (Cornell Univ., Ithaca, NY). pp 255-264 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

An attempt was made to measure the cross section for the production of the psi(3105) in order to compare the photoproduction cross section for the psi with those of the other vector mesons. It was found that the measured angular and energy spectra for the psi can be fitted by assuming an elastic production cross section for photon energies between 9.0 and 11.8 GeV. Also a search was made for other bosons (or leptons) of mass greater than 1.5 GeV that decay into two showering particles in order to establish the existence of a postulated spin-0 state of mass 3.0 GeV which can decay into two photons. No evidence was found for any new particle. Preliminary upper limits on the cross section times branching ratio are presented for some of the data. (JFP)

31241 REVIEW OF HIGH ENERGY PHOTOPRODUCTION. Silverman, A. (Cornell Univ., Ithaca, NY). pp 355-412 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The review of high energy photoproduction includes the photoproduction of rho, omega, phi, and rho' mesons, nuclear shadowing, inclusive photoproduction of rho and phi mesons, and a search for new vector particles. (JFP)

31242 PHOTOPRODUCTION EXPERIMENTS IN THE NUCLEON RESONANCE REGION. Fisher, H. M. (Rheinische Friedrich-Wilhelms-Univ., Bonn). pp 413-471 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The review of recent experimental achievements of photoproduction experiments in the nucleon resonance region covers the whole photon energy region up to 2.0 GeV in cms. Use is made of the known positions and widths of the resonances as determined from pion–nucleon scattering. Covered are the classical photoproduction experiments, any experimental results on single pion photoproduction on nucleons. (JFP)

31243 INELASTIC ELECTRON–NUCLEON SCATTERING EXPERIMENTS. Taylor, R. E. (Stanford Univ., CA). pp 679-707 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

New results are reported from single-arm inelastic electron scattering experiments. The analyses include hitherto unpublished data and give new information on the scaling of the nucleon structure functions. Inclusive e + p interactions are mainly considered. (JFP)

31244 REVIEW OF ELECTROPRODUCTION OF FINAL STATES. Wolf, G. (Deutsches Elektronen-Synchrotron, Hamburg). pp 795-853 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The review of electroproduction of final states covers exclusive final states and inclusive hadron spectra produced in electron- and muon--nucleon scattering. In general only new experimental data are discussed. Included are single pion production in the resonance region, charged pion production and the pion form factor, pi^0 electroproduction, gamma p yields pi^- DELTA^{++} and the axial vector form factor, vector meson production, Q^2 dependence of the rho^0 cross section, t dependence of gamma p yields rho^0 p, spin dependence of gamma p yields rho^0 p, and global features of electroproduced final states. (JFP)

31245 FIREBALL PARAMETERS IN COSMIC RAY JETS. Kaul, S. K.; Singh, S. (Univ. of Delhi). Indian J. Pure Appl. Phys.; 13: No. 8, 520-525(Aug 1975).

The production of fireballs in cosmic ray α-N jets is investigated in 11 cosmic ray jets having primary energy 0.1 to 1.0 TeV. To detect the presence of a fireball in an interaction, a

target plot based on the space and azimuthal angles of the secondaries was devised and employed in conjunction with the usual Duller-Walker plot. The parameters of these fireballs were determined by using the latest method of A. G. Agnese and A. Wataghin [Nuovo Cim., 6A(1971)1]. The average values of the mass, maximum decay temperature and the number of charged decay particles of the fireballs were found to be 1.69 ± 0.4) GeV, (152 ± 6) MeV/c and (5.5 ± 0.3) respectively. The fireball mass is observed to be independent of the multiplicity of the event and the energy of the incident particle. The observed parameters of fireballs agree well with the recently proposed cluster models. (auth)

31246 MEASUREMENT OF ASYMMETRY OF PHOTOPRODUCTION OF POSITIVE PIONS ON PROTONS BY LINEARLY POLARIZED PHOTONS IN 250 TO 500 MeV ENERGY RANGE. Ganenko, V. B.; Gorbenko, V. G.; Derkach, L. M. (Physical-Technical Inst., Kazan). Yad. Fiz.; 23: No. 1, 100-106(Jan 1976). (In Russian).

The experimental results of measuring the asymmetry of the cross section of $\gamma + p \rightarrow n + \pi^+$ reaction with linearly polarized photons are presented. The asymmetry values are obtained for 12 values of the photon energy in the range of 250 to 500 MeV (lab. system), and four c.m. angles of pion escape from 25 to 140°. The statistical accuracy is of ± (5 to 7)%, the systematical error is of ±4%. The present results are compared to other data. In the 250 to 500 MeV photon energy range the validity of S, P wave approximation for the process studied is verified. (auth)

31247 RATIO OF ASYMMETRIES OF PHOTOPRODUCTION CROSS SECTIONS OF POSITIVE PIONS ON DEUTERIUM AND HYDROGEN IN THE VICINITY OF THE FIRST RESONANCE. Ganenko, V. B.; Gorbenko, V. G.; Zhebrovskii, Yu. V.; Kolesnikov, L. Ya.; Krivets, A. G.; Miroshnichenko, I. I.; Nikiforov, V. I.; Rubashkin, A. L.; Sanin, V. M.; Sorokin, P. V.; Shalatskii, S. V. (Physical-Technical Inst., Kazan). Yad. Fiz.; 23: No. 1, 107-109(Jan 1976). (In Russian).

The ratio of asymmetries of the cross sections of the reactions $\gamma p \rightarrow n\pi^+$ and $\gamma d \rightarrow nn\pi^+$ in the photon linearly polarized beam is measured. The asymmetry ratio is obtained for 25 and 90° c.m. angles in the photon energy range 250 to 500 MeV. The angular distributions for 320 and 360 MeV energies are presented. The statistical accuracy of the experimental data is of 5%, the systematical error is of 6%. The ratio is equal to unity within the errors. (auth)

31248 INVESTIGATION OF HIGH MULTIPLICITY GAMMA EVENTS IN pp COLLISIONS WITH cm ENERGIES BETWEEN 22 AND 62 GeV. Dell, G. F. (CERN, Geneva); Uto, H.; Yuan, L. C. L.; Amaldi, E.; Beneventano, M.; Borgia, B.; Pistilli, P.; Sestili, I.; Dooher, J. Lett. Nuovo Cim.; 15: No. 8, 269-273 (21 Feb 1976).

Results of an exploratory experiment on the investigation of high multiplicity gamma events, carried out using colliding proton beams, are described. The main objective was to look for multi-gamma events which could reveal interesting features of π^0 multiple production as well as other possible mechanisms of gamma production. Evidence was found for the existence of multiparticle correlations. (JFP)

31249 SEPARATION OF THE TRANSVERSE AND LONGITUDINAL COMPONENTS OF THE CROSS SECTION FOR PION ELECTROPRODUCTION ON A PROTON AT THE THRESHOLD. Afanas'ev, N.G.; Esaulov, A.S.; Pilipenko, A.M.; Titov, Yu.I. JETP Lett. 22: No. 7, 189-190 (5 Oct 1975).

We report the results of inelastic scattering of electrons by protons at the threshold at $k^2 = 5\,F^{-2}$. We determine the quantities $|E_{0^+}|$ and $|S_{0^+}|$, from which we obtain the values of the axial-vector form factor of the nucleon and the form factor of the pion. (auth)

31250 EXISTENCE AND CLASSIFICATION OF PARTICLES. Casanova, G. C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 5, 257-260(4 Aug 1975). (In French)

Utilizing the nucleon theory to define generally isovectors in the proper space and introducing the strangeness from the charges and baryonic numbers, all the known particles independently of their mass and spins were classified. (FR)

31251 HADRON MULTIPLICITIES AND STRUCTURE FUNCTIONS —A COMPARISON OF MUOPRODUCTION WITH PHOTOPRODUCTION AND e^+e^- ANNIHILATION. Bunnell, K.; Duong-van, M.; Mozley, R.; Odian, A.; Villa, F.; Wang, L.C. (Stanford Linear Accelerator Center, Stanford, California 94305); del Papa, C.; Dorfan, D.; Flatté, S.M.F.; Heusch, C.A.; Lieberman, B.; Luxton, G.; Meyer, H.; Moss, L.; Schalk, T.; Seiden, A. Phys. Rev. Lett. 36: No. 14, 772-774 (5 Apr 1976).

We report on mean hadron multiplicities and structure functions observed in muon-proton collisions at 14 GeV/c. A remarkable agreement is found with photoproduction and e^+e^- annihilation data. (auth)

31252 DOUBLE POSITRON-ELECTRON PAIR PRODUCTION BY 6.6-MeV GAMMA RAYS. Robertson, A.; Kennett, T.J.; Prestwich, W.V. (Department of Physics, McMaster University, Hamilton, Ontario, Canada). Phys. Rev. C 13: No. 4, 1552-1565 (Apr 1976).

Double positron-electron pair production by 6.6-MeV γ rays was investigated via measurement of fourfold coincidence rates of annihilation quanta in targets of beryllium, boron, carbon, aluminum, sulphur, copper filings, and solid copper. Following an accounting for the interfering bremsstrahlung-cascade and direct-cascade effects a measure of the cross section for the process, relative to that for single pair production, was obtained as $\sigma_{ee}/\sigma_{\gamma} = (1.82 \pm 0.58) \times 10^{-3}$. (auth)

31253 OBSERVATION OF A RESONANCE AT 4.4 GeV AND ADDITIONAL STRUCTURE NEAR 4.1 GeV IN e^+e^- ANNIHILATION. Siegrist, J.; Abrams, G.S.; Boyarski, A.M.; Breidenbach, M.; Bulos, F.; Chinowsky, W.; Feldman, G.J.; Friedberg, C.E.; Fryberger, D.; Goldhaber, G.; Hanson, G.; Hartill, D.L.; Jaros, J.; Jean-Marie, B.; Kadyk, J.A.; Larsen, R.R.; Lüke, D.; Lüth, V.; Lynch, H.L.; Madaras, R.; Morehouse, C.C.; Nguyen, H.K.; Paterson, J.M.; Perl, M.L.; Peruzzi, I.; Pierre, F.M.; Piccolo, M.; Pun, T.P.; Rapidis, P.; Richter, B.; Sadoulet, B.; Schwitters, R.F.; Tanenbaum, W.; Trilling, G.H.; Vannucci, F.; Whitaker, J.S.; Winkelmann, F.C.; Wiss, J.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 36: No. 13, 700-703 (29 Mar 1976).

We observe a resonancelike structure in the total cross section for hadron production by e^+e^- colliding beams at a mass of 4414±7 MeV having a total width $\Gamma = 33 \pm 10$ MeV. From the area under this resonance, we deduce the partial width to electron pairs to be $\Gamma_{ee} = 440 \pm 140$ eV. Further structure of comparable width is present near 4.1 GeV. (auth)

31254 ANOMALOUS PRODUCTION OF HIGH-ENERGY MUONS IN e^+e^- COLLISIONS AT 4.8 GeV. Cavalli-Sforza, M.; Goggi, G.; Mantovani, G.C.; Piazzoli, A.; Rossini, B.; Scannicchio, D. (Istituto di Fisica Nucleare, Universita di Pavia); Coyne, D.G.; O'Neill, G.K.; Sadrozinski, H.F.W.; Shinsky, K.A.; Atwood, T.L.; Badtke, D.H.; Barnett, B.A.; Trasatti, L.V.; Zorn, G.T. Phys. Rev. Lett. 36: No. 11, 558-561 (15 Mar 1976).

In view of the possible production of heavy leptons or charmed states in e^+e^- collisions, we searched for anomalous muons with momenta $p_\mu \gtrsim 1$ GeV/c. The inclusive cross section for $n_{ch} \geq 3$ has an upper limit of 96 pb (assuming isotropy). For $n_{ch} = 2$ and noncoplanarity $> 20°$, an excess of muonic events is observed, corresponding to $(d\sigma/d\Omega)|_{90°} = 23^{+12}_{-9}$ pb/sr; the probability that known processes produce the observed events is 2×10^{-4}. (auth)

Weak

Refer also to abstract 29372.

31255 (CERN-Trans-74-9) MEASUREMENT OF THE POSITIVE MUON'S LIFETIME. Balandin, M. P.; Grebenyuk, V. M.; Zinov, V. G.; Konin, A. D.; Ponomarev, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). Sep 1974. 16p. (JINR-R-1-7892). INIS.

Translation from the Russian.

The mean lifetime of the positive muon at rest has been measured and found to be (2.19711 ± 0.00008 μs). The decay positrons have been detected with a Cherenkov water counter. Its radiator was simultaneously a target at the center of which the muons stopped. The 4π-detector geometry and the high detector efficiency allowed the increase of the counting rate and the suppression of some undesirable effects. (auth)

31256 Mu-PAIR PRODUCTION BY 150 GeV/c HADRONS. Pilcher, J. E. (Univ. of Chicago). pp 207-211 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The first results of a measurement of mu-pair production by 150-GeV/c protons and π^+ mesons are reported. Mass distributions for the two reactions are shown in which a clear J signal is seen at 3.1 GeV. The cross section ratio for these reactions is found. (JFP)

31257 LEPTON PRODUCTION IN HADRON COLLISIONS. Lederman, L. M. (Columbia Univ., New York). pp 265-316 of

Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The experimental status of the processes p +p yields l/sup +-/ +anything, l/sup +-/ e/sup +-/ or mu/sup +-/, and p +p yields $l^+ + l^-$ +anything is reviewed. (JFP)

31258 SEARCH FOR NEW INTERACTIONS IN HIGH ENERGY NEUTRINO COLLISIONS. Barish, B. C. (California Inst. of Tech., Pasadena). pp 511-525 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The Caltech-Fermilab apparatus was used to search for topologies which could signify new interactions for high energy neutrinos. A negative search for neutrino initiated events having a single muon of the wrong sign (mu^+) in the final state was performed. It provides a 90 percent C.L. of less than or equal to 4 10^{-3} for the rate relative to interactions giving negative muons. In the same apparatus, a search for events with two muons in the final state was also conducted. Events of this type were observed to occur at a level of approximately 10^{-2} of ordinary neutrino interactions. These 2 mu events, their characteristics, and possible interpretations are discussed in detail. (auth)

31259 RECENT RESULTS FROM THE BROOKHAVEN NATIONAL LABORATORY 7' BUBBLE CHAMBER. Samios, N. P. (Brookhaven National Lab., Upton, NY). pp 527-535 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

New results are presented on the ratio of neutrino cross sections on neutrons to that on protons. Also the parameters of all the other charged current events containing at least one strange particle are presented. (JFP)

31260 RECENT NEUTRAL CURRENT RESULTS FROM THE GARGAMELLE EXPERIMENT. Morfin, J. G. (Technische Hochschule, Aachen). pp 537-549 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

A brief report is given on the status of the anti nu/sub mu/ - e^- scattering experiment, and then the results for single pi^0 and strange particle production in neutral current interactions are discussed. (JFP)

31261 BUBBLE CHAMBER NEUTRINO RESULTS FROM FERMILAB. Roe, B. P. (Univ. of Michigan, Ann Arbor). pp. 551-568 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The discussion of nu p and anti nu p events includes diagrams of the events, various distributions and multiplicities, and DELTA S/DELTA Q searches in nu p data. (JFP)

31262 REVIEW OF NEUTRINO EXPERIMENTS. Perkins, D. H. (Oxford Univ.). pp 571-603 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The review covers the elastic processes, nu n yields mu^-p and nu p yields mu^+n, 1, 2, and 3 pi production, inclusive cross sections, scaling, x and y distributions, violations of charge symmetry and sum rules. Also evidence for and against the existence of heavy long-lived neutral leptons, suggested by the cosmic neutrino experiment, is discussed. (JFP)

31263 HIGH ENERGY MUON SCATTERING AT FERMILAB. Mo, L. W. (Univ. of Chicago). pp 651-677 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

Two muon experiments are reported: one is a test of Bjorken scaling with an iron target, finding scale noninvariance, and the other is a study of muon scattering from a liquid hydrogen/deuterium target, measuring inclusive cross sections, structure functions and various distributions. The results from these experiments are presented in turn after a brief description of the muon beam. Also a result from a lower energy experiment performed at Serpukhov on the study of parity-violating effects in deep inelastic mu N scattering is reported, with results on the asymmetry and coupling constant. (JFP)

31264 NEW PARTICLE PRODUCTION BY NEUTRINOS. Rubbia, C. (Harvard Univ., Cambridge, MA). pp 1049-1069 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

A review is given of the most recent experimental evidence for the production by neutrinos and the subsequent weak decay of new hadrons for the production by neutrinos and subsequent weak decay of new hadrons with a new quantum number violated by the weak interaction. It is noted that it is now well established that these new hadrons exist. They are most probably hadronic states with a new quantum number. They are copiously produced by neutrinos and antineutrinos at high energies. (JFP)

31265 *MEASUREMENT OF DECAY BRANCHING RATIOS FOR* THE /sub LAMBDA/^{4}He HYPERNUCLEUS. Keyes, G.; (Inter-University Inst. for High Energies, Brussels); Sacton, J.; Wickens, *J. H.; Block, M. M. Nuovo Cim.; 31A: No. 3, 401-410(1 Feb* 1975).

Decay branching ratios of the /sub LAMBDA/^{4}He hypernucleus were measured using a sample of hypernuclei produced in the interactions at rest of K^--mesons in a helium bubble chamber. The observation of 6 pi^+-mesonic decays leads to a value of 0.043 +- 0.017 for the pi^+-mesonic/pi^--mesonic decay branching ratio. No examples of the charged two-body nonmesonic decays of the hypernucleus were observed. (auth)

31266 NEUTRAL KAON REGENERATION ON CARBON IN THE MOMENTUM REGION OF 16-40 GeV/c. Birulev, V. K.; Deak, F.; Genchev, V.; Grigashvilli, T. S.; Guskov, B. N.; Hladky, J.; Ivanchenko, I. M.; Kekelidze, V. D.; Kiss, D.; Krivokhizin, V. G. Acta Phys. Slovaca; 24: No. 4, 24-231(1974).

From triangle meeting on weak interactions; Smolenice, Czechoslovakia (4 Jun 1973).

Preliminary results on the neutral kaon regeneration on carbon obtained by the 70-GeV/c Serpukhov accelerator are presented. (auth)

31267 ELASTIC NEUTRINO AND ANTINEUTRINO INTERACTIONS. Rollier, M. pp 349-355 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

Preliminary results on the elastic reaction of neutrino and antineutrino are compared with the predictions of classical V-A theory with CVC assumption. (FR)

31268 PRELIMINARY RESULT ON NEUTRINO-NEUTRON AND NEUTRINO-PROTON CHARGED CURRENT CROSS SECTIONS RATIO. Haguenauer, M. pp 327-330 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

Preliminary results are presented on the total cross section ratio for neutrino-neutron and neutrino-proton charged current interactions (R = 2.1 ± 0.3). (FR)

31269 NEUTRAL WEAK CURRENTS AND NEW PARTICLE PRODUCTION. Mann, A. K. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). pp 273-288 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

The neutral weak current channel provides a means of searching for a variety of new massive particles, including charged and

neutral heavy leptons and neutral bosons, in high energy neutrino interactions. A discussion of the method and preliminary results from present data are given. (FR)

31270 FURTHER RESULTS ON MUON–ANTINEUTRINO–ELECTRON SCATTERING. Hasert, F. J. (Technische Hochschule, Aachen (F. R. Germany)). pp 257-264(2) of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

In a further study of the neutral current interactions muon-antineutrino $e^- \rightarrow$ muon-antineutrino e^-, the Gargamelle collaboration analyzed 70% of the photographic film from the Freon neutrino (antineutrino) experiment. Three non-ambiguous events were found that correspond with a 90% confidence to an upper limit for the cross section below $0.17 \times 10^{-41} cm^2/e^-$. A 0.46 event background was calculated, and the probability for the three events to be background is lower than 1%. Signal loss corrections were effected in terms of the Salam-Ward-Weinberg model, and an upper limit ($\sin^2\theta(W) < 0.45$) was found for the Weinberg angle. Taking account for the previous results obtained by the Gargamelle collaboration for this reaction, the limits of $\sin^2\theta(W)$ are concluded to be $0.1 < \sin^2\theta(W) < 0.45$. (FR)

31271 NEUTRAL PION PRODUCTION BY WEAK NEUTRAL CURRENTS IN NEUTRINO AND ANTINEUTRINO REACTION. Vialle, J. P. pp 225-238 of High Energy Neutrino Physics, Paris, Mar 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

One π^0 production by weak neutral currents has been observed in the CERN-GARGAMELLE neutrino experiment. Bounds are given on the ratio of this reaction to the corresponding one with charged currents for neutrino beam ($0.11 < R(\text{neutrino}) < 0.22$). Preliminary results are given for antineutrinos. (FR)

31272 *STRANGE PARTICLE PRODUCTION AND CHARMED* PARTICLE SEARCH IN GARGAMELLE NEUTRINO EXPERIMENT. Nguyen-Khac, U. pp 173-181 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

Only muon-neutrino and muon-antineutrino interactions producing one or two strange particles in the final state are studied. The neutral-current (SNC) and charged-current (SCC) interactions are analyzed: R = (SNC/SCC) = 0.29 ± 0.14 for both $\Delta S = 0$ and $\Delta S = 1$ contributions. Cross section limits for charmed particle production were estimated for the energy band 2-10 GeV. (FR)

31273 EVIDENCE FOR CHARMED BARYON PRODUCTION BY NEUTRINOS. Cazzoli, E. G.; Cnops, A. M.; Connolly, P. L.; Louttit, R. I.; Murtagh, M. J.; Palmer, R. B.; Samios, N. P.; Tso, T. T.; Williams, H. H. (Brookhaven National Lab., Upton, N. Y. (USA)). pp 155-171 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

The production by neutrinos of an event with negative strangeness is reported. In an exposure of the BNL 7 ft. Cryogenic Bubble Chamber to a broad-band neutrino beam 335 events were observed, one of which fits the reaction neutrino proton $\rightarrow \lambda^- \pi^0 \pi^+ \pi^+ \pi^+ \pi^-$. Alternative explanations are examined and none found with a probability greater than $3\ 10^{-5}$. The event thus represents a large violation of the $\Delta S = \Delta Q$ rule or alternatively the production and decay of a charmed baryon state. The most plausible mass for this state is found to be 2426 + 12 MeV. (FR)

31274 PRELIMINARY RESULTS OF ITEP-IHEP SPARK CHAMBER NEUTRINO EXPERIMENT AT SERPUKHOV ACCELERATOR. Asratyan, A. E.; Epshtein, V. S.; Grigoriev, E. A.; Emanov, V. A.; Kaftanov, V. S.; Kalganov, N. V.; Khovanskii, V. D.; Kornelyuk, Yu. G.; Kubantsev, M. A.; Maksimov, I. P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst, Teoreticheskoj i Ehksperimental'noj Fiziki). pp 151-154 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

First results of the ITEP-IHEP spark chamber neutrino experiment are reported. Conditions of exposure and preliminary results in the first runs are described. (FR)

31275 EVIDENCE FOR NEW PARTICLE PRODUCTION FROM THE BREAKING OF SCALE INVARIANCE IN HIGH ENERGY NEUTRINO AND ANTINEUTRINO COLLISIONS. Cline, D. B. (Wisconsin Univ., Madison (USA)). pp 107-130 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

Accumulating evidence for the breaking of scale invariance obtained in the Harvard-Pennsylvania-Wisconsin-Fermilab neutrino experiment is presented. The emphasis of this report is for a consistent presentation of the various phenomena related to the hadronic distributions and interpretation invoking the production of one or more new particles. (FR)

31276 DIMUON PRODUCTION BY PHOTONS AND NEUTRONS. Knapp, B.; Lee, W.; Leung, P.; Smith, D.; Wijangco, A. (Columbia Univ., New York (USA)); Knauer, J.; Yount, D. (Hawaii Univ., Honolulu (USA)); Nease, D. (Cornell Univ., Ithaca, N. Y. (USA)); Bronstein, J.; Coleman, R. pp 61-78 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

A resonance production was observed at 3.1 GeV/c^2 in the reactions $\gamma + Be \rightarrow \mu^+\mu^- + X$ and $n + Be \rightarrow \mu^+\mu^- + X$. The cross section and t distribution are presented for both reactions. (FR)

31277 SINGLE π PRODUCTION IN NEUTRINO INTERACTIONS. Lee, W.; Maddry, E.; Sippach, W.; Sokolsky, P.; Teig, L. (Columbia Univ., New York (USA)); Chapin, T.; Holloway, L.; Nodulman, L.; O'Halloran, T.; Pang, C. (Illinois Univ., Urbana (USA)). pp 205-224 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

An experiment performed at the BNL AGS to study neutral-current single π production by neutrinos is reported. The reactions studied are: muon-neutrino + N → muon-neutrino N π^0, or μ^- N' π^0, or muon-neutrino N' π^+, or μ^- N' π^+, where N is a complex nucleus (75% Al and 25% C) and N' may include nucleons from nuclear breakup. Results of the π^0 final state only are presented. (FR)

31278 ADONE STATUS REPORT. Peruzzi, I. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). pp 43-60 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

The present status of Adone experiments is reported. Preliminary result have been obtained for the partial widths of $\psi(3.1)$ into many-hadrons, e^+e^-, $\mu^+\mu^-$, $\pi^0\gamma$. No clear evidence for the decay $\psi \rightarrow \gamma\gamma$ has been found. The energy region between 1.9 and 3.0 GeV has been scanned in order to search for other narrow resonances. (FR)

31279 PRELIMINARY RESULTS OF A SEARCH FOR THE HADRONIC ELASTIC NEUTRAL CURRENT REACTION MUON–ANTINEUTRINO PROTON → MUON–ANTINEUTRINO PROTON. Escoubes, B. pp 265-271 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

Preliminary results from a search for elastic hadronic neutral currents induced by neutrinos on free protons are reported. A first estimation of the upper limit for the elastic cross section ratio neutral-current/charged-current is obtained from antineutrinos. The result that bears only on a small part of the total statistics constitutes essentially an indication of the possibility of measuring this ratio. (FR)

31280 SIMULTANEOUS PRODUCTION OF TWO MUONS BY HIGH ENERGY NEUTRINOS AND ANTINEUTRINOS. Benvenuti, A.; Cline, D.; Ford, W. T.; Imlay, R.; Ling, T. Y.; Mann, A. K.; Messing, F.; Orr, R.; Reeder, D. D.; Rubbia, C. (Harvard Univ., Cambridge, Mass. (USA). Dept. of Physics; Pennsylvania Univ., Philadelphia (USA). Dept. of Physics; Wisconsin Univ., Madison (USA). Dept. of Physics; Fermi National Accelerator Lab., Batavia, Ill. (USA)). pp 91-106 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

Neutrino interaction investigation reveals approximately 1 percent events with two muons. An analysis of the background due to pi and K meson in-flight decays allows a lepton production from a new source to be deduced (heavy lepton, new particle). (FR)

31281 OBSERVATION OF $\mu^- e^+ K_s^0$ EVENTS PRODUCED BY A NEUTRINO BEAM. von Krogh, J.; Fry, W.; Camerini, U.; Cline, D.; Loveless, R.J.; Mapp, J.; March, R.H.; Reeder, D.D. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706); Barbaro-Galtieri, A.; Bosetti, P.; Lynch, G.; Marriner, J.; Solmitz, F.; Stevenson, M.L.; Haidt, D.; Harigel, G.; Wachsmuth, H.; Cence, R.; Harris, F.; Parker, S.I.; Peters, M.; Peterson, V.; Stenger, V. Phys. Rev. Lett. 36: No. 13, 710-713 (29 Mar 1976).

Four events have been observed with an e^+ and a K_s^0 decay in the final state induced by a neutrino beam incident on the Fermilab 15-ft neon bubble chamber. Conventional backgrounds are unable to account for these events. Two of the events have in addition a μ^- in the final state clearly identified by the external muon identifier. The other two have μ^- candidates. (auth)

31282 ELIMINATION OF CHARMED MESONS AS SOURCE OF ANOMALOUS LEPTON EVENTS IN e^+e^- ANNIHILATIONS. Snow, G.A. (University of Maryland, College Park, Maryland 20742). Phys. Rev. Lett. 36: No. 14, 766-768 (5 Apr 1976).

An analysis of the Maryland-Pavia-Princeton experiment on inclusive muon production in e^-e^+ annihilations yields an upper limit for the ratio of charged-multiplicity events from the particle U, charge conjugate to the particle $\bar{U}$ that produced the muon, of $[U \to (n_{ch} \geq 3)]/[U \to (n_{ch} = 1)] < 0.33$. If U were a charmed meson, this ratio would be >2, a prediction incompatible with the data. The predicted ratio for U a heavy lepton is ~ 0.18, in good agreement with experiment. (auth)

31283 EXPERIMENTAL STUDY OF INCLUSIVE DEEP INELASTIC NEUTRINO-PROTON SCATTERING. Berge, J.P.; Bogert, D.; DiBianca, F.A.; Cundy, D.C.; Dunaitsev, A.; Efremenko, V.; Ermolov, P.; Fowler, W.; Hanft, R.; Harigel, G.; Huson, F.R.; Kolganov, V.; Mukhin, A.; Nezrick, F.A.; Rjabov, Y.; Scott, W.G.; Smart, W. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510); Coffin, C.T.; Diamond, R.N.; French, H.; Louis, W.; Roe, B.P.; Seidl, A.A.; Vander Velde, J.C. Phys. Rev. Lett. 36: No. 12, 639-642 (22 Mar 1976).

A neutrino-proton scattering experiment has been performed at Fermilab using a wide-band horn-focused neutrino beam and the 15-ft bubble chamber filled with hydrogen. For the inclusive reaction $\nu_\mu + p \to \mu^- +$ hadrons, the mean value of Q^2 is found to increase linearly with energy as is expected from Bjorken scaling and a fit to the data gives $\langle Q^2 \rangle = (0.18 \pm 0.01)\ E$. The distribution in the Bjorken scaling variable x shows evidence for deviations from predictions based on electron-scattering data and the quark-parton model. (auth)

Strong (Baryon-induced)

Refer also to abstract 31673.

31284 (CRN-HE-75-9) IMPACT PARAMETER REPRESENTATION OF THE LEADING PROTON SPECTRUM IN THE DIFFRACTIVE REGION. Barshay, S. (Centre National de la Recherche Scientifique, 67—Strasbourg (France). Centre de Recherches Nucleaires). 1975. 9p. INIS.

Recent experiment indicates that there is no limiting value for the pion invariant inclusive cross section at x = 0 at the highest energies reached by the CERN intersecting storage rings. The first remark is that a recently proposed integral representation of the leading proton spectrum is physically equivalent to present this spectrum in terms of very narrow multiplicity distributions from each initial impact parameter with a single factorizable function to the average multiplicity at any impact parameter b, $< n(s,b/R(s)) \geq N(s)n(b/R(s))$. In this approach, the explicit form for the scaled part of the spectrum for x 0.97 and P(T) 0 depends essentially upon the assumed asymptotic form for the growth of average multiplicity with energy s. (FR)

31285 (JINR-P1-9265) HIGH-MOMENTUM PARTS OF SPECTRA OF SECONDARY PARTICLES PRODUCED IN COLLISIONS OF 6.3 GeV/c DEUTERONS WITH PROTONS, DEUTERONS, AND CARBON NUCLEI. Azhgiri, L. S.; Vzorov, I. K.; Zhmyrov, V. N.; Ivanov, V. V.; Ignatenko, M. A.; Kuznetsov, A. S.; Meschercov, M. G.; Razin, S. V.; Stoletov, G. D. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The high-momentum parts of spectra of secondary particles emitted at an angle of 103 mrad in the laboratory system produced in the interactions of 6.3-GeV/c deuterons with protons, deuterons and carbon nuclei were measured using the magnetic spectrometer with the wire spark chambers on-line with the computer. The structure of the spectra measured shows that multiple N-N-scatterings are significant in the nuclear interactions of deuterons at $|t| \approx 0.4$ (GeV/c)^2. (auth)

31286 ACCELERATION OF POLARIZED PROTONS TO MULTI-GeV ENERGIES AND EXPERIMENTS WITH POLARIZED PROTONS FROM 2 TO 6 GeV/c. Ratner, L. G. (Argonne National Lab., IL). Czech. J. Phys.; B26: No. 1, 34-54(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

Acceleration of polarized protons, experiments with polarized protons, proton–proton total cross section, two and three spin proton elastic scattering measurements, polarization measurements in nucleon–nucleon elastic scattering, inelastic interactions, inclusive lambda production, coherent polarized proton ^{4}He interactions, and parity tests are discussed. (auth)

31287 PRESENT STATUS OF THE EXPERIMENTAL TESTING OF THE FORWARD $K^\pm p$ AND pp, $\bar{p}p$ DISPERSION RELATIONS. Dumbrajs, O.; Staszel, M. (Univ., Warsaw). Czech. J. Phys.; B26: No. 1, 68-80(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

A brief survey of the present status of the experimental testing of the forward $K^\pm p$ and pp, $\bar{p}p$ dispersion relations is given. Some general questions concerning the experimental determination of the real part of the forward scattering amplitude are concerned. Recently developed forms of dispersion relations and of their substitutes are discussed. (auth)

31288 IS $(\ln s)^2$ RISE IN NUCLEON–NUCLEON TOTAL CROSS SECTION EXCLUDED BY COSMIC RAY DATA. Formanek, J. (Charles Univ., Prague). Czech. J. Phys.; B26: No. 1, 81-85(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

The problem of extraction of nucleon–nucleon total cross section from data on zenith angle dependence of frequencies of extensive air showers is discussed. It is shown that one cannot in this way distinguish even between asymptotically constant cross section and that increasing like $(\ln s)^2$. (auth)

31289 REACTION $\bar{p}p \to 3\pi^- 3\pi^+$ BETWEEN 1.09 AND 1.44 GeV/c AND THE EFFECT OF $\pi\pi$ PHASE SHIFTS. Gay, J. B. (Univ., Neuchatel, Switzerland); Jeanneret, J. B.; Bogdanski, M.; Jeannet, E. Nuovo Cim., 31A: No. 4, 593-604(21 Feb 1976).

Experimental results for the cross sections, the effective-mass distributions, the angular distributions and correlations are presented for the reaction $\bar{p}p \to 3\pi^- 3\pi^+$. All the multipion mass distributions and the $\pi\pi$ angular correlations are described in terms of a final-state interaction model including the δ_0^0 and δ_1^1 $\pi\pi$ phase shifts, as well as an A_2 effect. (auth)

31290 SOME CROSS SECTIONS FOR THE PHOTO-PRODUCTION OF NEUTRAL Pi-MESONS FROM HYDROGEN AT ENERGIES FROM 360 TO 938 MeV. Dougan, P.; Ramsay, V.; Stiefler, W.; Kivikas, T.; Lugner, F. K. (Lund Univ. (Sweden). Fysiska Institutionen). Z. Phys., A; 274: No. 1, 73-78(Aug 1975).

7 figs.; 1 tab.; 15 refs.

Some cross sections for the photo-production of π^0-mesons from hydrogen for pion cm angles in the range 60^0-125^0 are presented. The data have been obtained by measuring proton yields from a hydrogen target, thus permitting separation of single-pion production from the strong background caused by double-pion production. The values, which extend from 360 to 938 MeV, show reasonable agreement with the results of a recent phase-shift analysis. (DE)

31291 TOTAL CROSS SECTIONS AND FORWARD NUCLEAR AMPLITUDES. Amaldi, U. (CERN, Geneva). Czech. J. Phys.; B26: No. 1, 4-12(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

The most recent data on hadron–hadron total cross sections and forward nuclear amplitudes are reviewed. The experiments which, in this field, are either under way or in preparation, are discussed. (auth)

31292 MEASUREMENTS OF THE SPIN ROTATION PARAMETER R IN HIGH ENERGY ELASTIC SCATTERING AND HELICITY AMPLITUDES AT SERPUKHOV ENERGIES. Serpukhov, Saclay, Dubna, Moscow Collaboration. Czech. J. Phys.; B26: No. 1, 13-24(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

The spin rotation parameter R in pp and $\pi^+ p$ elastic scattering at 45 GeV/c was measured at the Serpukhov accelerator, for $|t|$ ranging from 0.2 to 0.5 (GeV/c)^2. The results are presented, together with previous R measurements at lower energies, and are compared with the predictions of Regge pole models. The equality of the values for R in proton–proton and pion–proton

scattering, within the experimental errors, is a test of factorization of the residues. An s-channel helicity amplitude analysis for pion-nucleon scattering at 40 GeV/c is made using all available data. Significant results are obtained for the isoscalar exchange amplitudes. The helicity flip in isoscalar exchange is nonnegligible. The energy dependence of this amplitude, at 6, 16 and 40 GeV/c, is compared with predictions of Regge pole models. (auth)

31293 POLARIZATION MEASUREMENTS IN HIGH ENERGY ELASTIC SCATTERING OF PIONS, KAONS, PROTONS, AND ANTIPROTONS ON PROTONS AND COMPARISON WITH REGGE PHENOMENOLOGY. Serpukhov, Saclay, Dubna, Moscow Collaboration. Czech. J. Phys.; B26: No. 1, 25-33(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

The polarization parameter P was measured for elastic scattering on polarized protons, of π^-, K^- and $\bar{p}$ at 40 GeV/c and of π^+, K^+ and p at 45 GeV/c. Four-momentum transfer ranges from -0.08 to 1.8 $(GeV/c)^2$ for π^-p, and from -0.08 to about -1.0 $(GeV/c)^2$ for p, π^+, K^+ and $\bar{p}$. The angular distribution of the polarization in π^-p exhibits the well known nonsense double zero at $t = -0.6$ $(GeV/c)^2$. The K^-p and $\bar{p}p$ results are compatible with exchange degeneracy for $|t|_0 < 0.5$ $(GeV/c)^2$. The energy dependence of the polarization P(t) in π^-p and in K^+p above 10 GeV/c incident momentum is compatible with interference between Pomeron and Regge poles. On the contrary, the polarization in pp elastic scattering decreases faster than ordinary Regge model predictions. This result can be explained by interference between nonflip and flip amplitudes of the Pomeron, leading to negative values for the polarization. (auth)

31294 LARGE TRANSVERSE MOMENTUM PROCESSES IN HADRON COLLISIONS. Di Lella, L. (CERN, Geneva). pp 939-965 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

Recent experimental results on single-particle inclusive distributions at transverse momentum and data on particle correlations in large transverse momentum final states are reviewed. Emphasis is placed only on those experiments in which at least one large transverse momentum particle is emitted at large angles. (JFP)

31295 SOME FEATURES IN RAPIDITY SPACE OF MULTIPARTICLE PRODUCTION BY PROTON–PROTON COLLISION AT 102 GeV/c. Homma, Y. (Osaka City Univ.); Kushumoto, O.; Okusawa, T.; Teranaka, M.; Konishi, T.; Ochiai, F.; Yokota, J.; Fujioka, G.; Hayashino, T. Lett. Nuovo Cim.; 15: No. 7, 235-239(14 Feb 1976).

Charge transfer at the maximum gap of rapidity space, that is, charge transfer at the gap where the difference of the rapidity between neighboring charged particles in each event is maximum, is studied for multiparticle production induced by the proton–proton collision at 102 GeV/c. It is found that the transferred charge at the maximum gap is mainly neutral. (JFP)

31296 Pd AND pi^+d COLLISIONS AT 100 GeV/c. Vander Velde, J. C. (Univ. of Michigan, Ann Arbor). Acta Phys. Pol., Ser. B; B7: No. 3, 211-219(Mar 1976).

From an exposure of the 30-inch deuterium bubble chamber at Fermilab 7600 events with greater than or equal to 3 charged prongs are examined. Multiplicity distributions for pi^+n, pn, and pd collisions are presented and are in general agreement with those expected based on knowledge of pi^-p and pp collisions at the same energy. The pd distribution is slightly wider than expected from a combination of free pp and pn collisions, and one estimates from this that the fraction of double inelastic collisions is about 5 percent. From the fraction of events with spectator protons it is found that in about 15 percent of the inelastic break-up collisions both nucleons participate. No significant N-dependence is found in the double interaction effects so that the odd-prong multiplicities presented should correspond closely to free pn and pi^+n collisions. An interpretation of these results is suggested. (auth)

31297 TOTAL CROSS SECTIONS AND ELASTIC SCATTERING AT VERY HIGH ENERGIES. Ciacomelli, G. (National Accelerator Lab., Batavia, Ill. (USA)). pp 247-277 of Proceedings of the Canadian Institute of Particle Physics Summer School, McGill University, 1973. Henzi, R.; Margolis, B. (eds.). Montreal, Quebec; The Institute of Particle Physics (1973).

From Canadian Institute of Particle Physics summer school; Montreal, Quebec, Canada (27 Aug 1973). (McGill Univ., Montreal, Quebec (Canada)).

Experimental results from the CERN-ISR on high energy and elastic proton-proton scattering are presented, particularly total cross sections and angular distributions. Emphasis is placed on the rising k_p^+ and pp total cross sections, the change of sign of the ratio of the real and imaginary part of the forward pp scattering amplitude and the diffraction-like structure of the pp angular distribution. It appears that both the elastic and the inelastic total pp cross sections are rising with energy. (MGH)

31298 ENERGY DEPENDENCE OF THE PARAMETER C_{NN} IN *pp* ELASTIC SCATTERING BETWEEN 2 AND 6 GeV/c. Miller, D.; Wilson, C. (Northwestern University, Evanston, Illinois 60201); Giese, R.; Hill, D.; Nield, K.; Rynes, P.; Sandler, B.; Yokosawa, A. Phys. Rev. Lett. 36: No. 14, 763-765 (5 Apr 1976).

We have measured the spin-spin correlation parameter C_{NN} at 2, 3, 4, and 6 GeV/c over the $|t|$ range of 0.1 to 2.0 $(GeV/c)^2$ and have observed a striking energy and $|t|$ dependence in C_{NN}. Polarization data were simultaneously collected and are compared to previous results. (auth)

31299 ISOTROPY OF COSMIC RAYS WITH ENERGIES 5 TeV TO 100 TeV. Barrowes, S.C.; Bergeson, H.E. (Department of Physics, University of Utah, Salt Lake City, Utah 84112). Phys. Rev. D 13: No. 3, 554-557 (1 Feb 1976).

A cosmic-ray isotropy measurement was carried out using about 10^6 underground muon events. The directional properties of the detector allowed events to be separated into bins according to the depth of rock penetrated and the celestial angles of the primary particles. The result at a median primary energy of 12 TeV, for muons penetrating an average depth of 2.9×10^5 g cm^{-2}, was a diurnal anisotropy of (0.1 ± 0.2) %. No single $10° \times 10°$ angular bin showed a significant excess of particles. The deviation from the expected numbers per bin showed a normal distribution with standard deviation no larger than that expected from counting statistics. This allowed a limit to be set on the angular roughness of the cosmic-ray flux. (auth)

31300 INTERACTIONS OF 300-GeV PROTONS WITH TUNGSTEN AND CHROMIUM. Florian, J.R.; Lee, M.Y.; Lord, J.J.; Martin, J.W.; Wilkes, R.J. (Department of Physics, University of Washington, Seattle, Washington 98195); Gibbs, R.E.; Kirkpatrick, L.D. Phys. Rev. D 13: No. 3, 558-565 (1 Feb 1976).

Targets consisting of tungsten and chromium powders imbedded in nuclear emulsion were exposed to the 300-GeV proton beam at the Fermi National Accelerator Laboratory. For each event found, the number of minimum-ionizing (shower) tracks n_s and the number of heavily ionizing tracks N_h were determined, and the production angles of the shower tracks were measured. For 39 chromium events, we find $\langle n_s \rangle = 13.8 \pm 1.2$, $\langle N_h \rangle = 7.2 \pm 0.7$, and $\langle -\ln \tan(\theta_{lab}/2) \rangle \equiv \langle r \rangle = 3.32 \pm 0.07$. For 51 events in tungsten, we find $\langle n_s \rangle = 18.6 \pm 1.5$, $\langle N_h \rangle = 12.9 \pm 1.2$, and $\langle r \rangle = 2.83 \pm 0.06$. The ratio $R \equiv \langle n_s \rangle / \langle n_s \rangle_p$ where $\langle n_s \rangle_p$ is the average charged multiplicity in *p-p* collisions, agrees with the form $R = 1/2 + \bar{\nu}/2$, where $\bar{\nu}$ is the mean number of intranuclear collisions. However, no single model adequately explains both the multiplicity and the angular distribution data. (auth)

31301 LORENTZ-INVARIANT ANALYSIS OF NUCLEON-NUCLEON COLLISIONS AT 24 GeV/c. Chowdhury, A.R.; Daftari, I.K.; Roy, T.; Ghosh, D.C. (Department of Physics, Jadavpur University, Calcutta-32, India). Phys. Rev. D 13: No. 5, 1502-1503 (1 Mar 1976).

Data obtained from emulsion plates exposed to a 24-GeV/c proton beam are presented in a manner suitable for observation from all Lorentz frames, following an idea presented in a recent paper by Biswas. The convenience of such a plot is discussed. (auth)

31302 PRECISION MEASUREMENT OF *n-p* CHARGE-EXCHANGE CROSS SECTION AT 647 MeV. Evans, M.L.; Glass, G.; Hiebert, J.C.; Jain, M.; Kenefick, R.A.; Northcliffe, L.C. (Texas A & M University, College Station, Texas 77843); Bonner, B.E.; Simmons, J.E.; Bjork, C.W.; Riley, P.J.; Bryant, H.C.; Cassapakis, C.G.; Dieterle, B.; Leavitt, C.P.; Wolfe, D.M.; Werren, D.W. Phys. Rev. Lett. 36: No. 10, 497-500 (8 Mar 1976).

The differential cross section for *n-p* elastic scattering in the angular region $145° < \theta_{c.m} < 180°$ has been measured with high statistical accuracy using the monoenergetic neutron beam at Clinton P. Anderson Meson Physics Facility. The results differ significantly from previous Dubna and Princeton-Pennsylvania Accelerator results but agree reasonably well with recent Saclay data except at extreme backward angles. (auth)

31303 FEATURES OF DIFFRACTION DISSOCIATION OF NEUTRONS IN *np* COLLISIONS AT 50–300 GeV/c. Biel, J.; Bleser, E.; Ferbel, T.; Freytag, D.; Gobbi, B.; Kenah, L.; Rosen, J.; Ruchti, R.; Slattery, P.; Underwood, D. (University of Rochester, Rochester, New York 14627). Phys. Rev. Lett. 36: No. 10, 504-507 (8 Mar 1976).

We present preliminary results from an investigation of the reaction $n+p \rightarrow (p\pi^-)+p$ for neutron momenta in the range of 50 to 300

GeV/c. The data display a strong correlation between the mass of the $p\pi^-$ system and the four-momentum transferred in the production. Cross sections for producing low-mass ($p\pi^-$) systems are independent of energy to within 10% accuracy. (auth)

31304 DECAY PROPERTIES OF $p\pi^-$ SYSTEMS PRODUCED IN NEUTRON DISSOCIATION AT 50–300 GeV/c. Biel, J.; Bleser, E.J.; Duke, D.; Ferbel, T.; Freytag, D.; Gobbi, B.; Kenah, L.; Rosen, J.; Ruchti, R.; Slattery, P.; Underwood, D. (University of Rochester, Rochester, New York 14627). Phys. Rev. Lett. 36: No. 10, 507-510 (8 Mar 1976).

We have examined the decay angular distributions of ($p\pi^-$) systems produced in the reaction $n+p\rightarrow(p\pi^-)+p$ for neutron momenta between 50 and 300 GeV/c. The production process appears to be dominated by comparable contributions from both the pion-exchange Deck mechanism and the proton-exchange Deck mechanism. (auth)

31305 FINAL-STATE INTERACTION EFFECTS IN INCLUSIVE γ AND V^0 PRODUCTION FROM *pd* INTERACTIONS AT 18 GeV/c. Butler, W.R. (David Lipscomb College, Nashville, Tennessee 37203); Reucroft, S.; Waters, J.W.; Webster, M.S. Phys. Rev. Lett. 36: No. 12, 633-636 (22 Mar 1976).

Direct evidence is presented for final- (and/or initial-) state interaction effects in 18 GeV/c *pd* reactions involving inclusive γ and V^0 production. This evidence is manifested as an excessive number of protonlike events as compared to the number of neutronlike events; an asymmetric distribution in center-of-mass longitudinal V^0 momentum for the protonlike events; and strong spectator-proton production-angle asymmetry correlated with high-momentum spectators. (auth)

Strong (Meson-induced)

31306 (CEA-CONF-3166) $K^+d \rightarrow K^+\pi^+\pi^-d$ AT 8.25 GeV/c. Burlaud, D.; Sene, M.; Cornet, P.; Grard, F.; Hendrickx, K.; Henri, V. P.; Windmolders, R.; Ginestet, J.; Vignaud, D.; Tavernier, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). 1975. 21p. INIS.

From 1975 high energy particle physics conference; Palermo, Italy (23 Jun 1975).

The reaction $K^+d \rightarrow K^+\pi^+\pi^-d$ at 8.25 GeV/c is analyzed using data from an exposure of the CERN 2m bubble chamber filled with deuterium. The main characteristics of the reaction are the presence of the Q and d* enhancements respectively in the $K\pi\pi$ and $d\pi$ mass spectra. These two phenomena are studied and the results are compared with results obtained at other energies. (FR)

31307 (CERN-Trans-74-3) A METHOD FOR RECONSTRUCTING A SPECTRUM OF π^0-MESON MOMENTA FROM THE γ-QUANTUM SPECTRA. Angelov, N. S.; Grishin, V. G.; Kopylov, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). Mar 1974. 16p. (JINR-R-1-7546). INIS.

Translation from the Russian.

A method for reconstruction of longitudinal and transverse momentum distributions of π^0-mesons in inclusive reactions is described. There exists a unique dependence between the experimental spectra of single γ-quanta from π^0-decays and the real spectra of π^0-mesons. This dependence can be expressed by a Fredholm equation of the first type. The method of statistical regularization appears to be applicable to this incorrect problem. The method was tested for rather poor efficiency of γ-detection. The accuracy of the spectra reconstruction has been checked by means of Monte-Carlo imitation of real processes. The longitudinal and transverse momentum spectra of π^0-mesons have been obtained on the basis of about 3000 γ-quanta in the reaction $\pi^- + p \rightarrow \gamma + \ldots$ at the incident π^--momentum P = (40.00 ± 0.24) GeV/c. The possibility to apply the method to a wide range of problems in high energy physics is pointed out. (auth)

31308 (DL/R-34) THREE PARTICLE PHASE SHIFT ANALYSIS AND MESON RESONANCE PRODUCTION. Proceedings of a Conference Held in Daresbury, England, 1–2 February 1975. Daresbury Study Weekend Series No. 8. Dainton, J. B.; Hey, A. J. G. (Eds.). (Science Research Council, Daresbury (UK). Daresbury Lab.). 1975. 132p. (CONF-750237–). Daresbury Laboratory, Daresbury, Warrington, England.

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975).

Sixteen papers were presented, fifteen of which are given in the proceedings and for which separate abstracts were prepared. (UK)

For abstracts of individual papers see: 31316–31320, 31355, 31356, 31488, 31516–31519, and 31533–31535.

31309 (FRNC-TH-581) π^+n INTERACTIONS AT 11.7 GeV/c WITH PRODUCTION OF FIVE CHARGED PARTICLES IN THE FINAL STATE. Moreira Brandao, M. A. (Paris-6 Univ., 75 (France)). 1975. 131p. (In French). INIS.

The production of five charged particles in π^+n interactions at 11.7 GeV/c was studied. The main results obtained are given. The cross-sections found were: reaction A, $\pi^+n \rightarrow p\pi^+\pi^+\pi^-\pi^-$, $\sigma = 388 \pm 32$ μb; reaction B, $\pi^+n \rightarrow p\pi^+\pi^+\pi^-\pi^-\pi^0$, $\sigma = 450 \pm 290$ μb; reaction C, $\pi^+n \rightarrow n\pi^+\pi^+\pi^+\pi^-\pi^-$, $\sigma = 541 \pm 108$ μb. These results contribute to the description of conjugated charge reactions. The function representing the non-resonant background was obtained by modifying the statistical phase space with a weight accounting for experimental observations. Meson resonances are produced more abundantly than baryon resonances, and the associated production is practically inexistent. Independently of resonance production, the study of p_T and p_L for the final particles shows that the leading particle effect is strong, and analysis in the longitudinal phase space shows that processes with $/\Delta Q/ = 1$ are dominant. The different rapidity distributions are well described by models of the noncorrelated jet type or the CLA type (Chang-Hong-Mo, Loskiewicz, and Allison), apart from a small number of events where the final particle rapidities lies around Y = O. (FR)

31310 (KFK-2209) PHOTOPRODUCTION OF PHI-MESONS AT SMALL MOMENTUM TRANSFER. Hirschmann, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Sep 1975. 114p. (In German). INIS.

The differential cross section of the $\gamma p \rightarrow \Phi, p \rightarrow K^+K^-p$ reaction is determined for four-momentum transfer (0 to 0.23) GeV^2 and for photon energies (4.6 to 6.62) GeV with very small error. The differential cross section is independent of energy, the dependence on four-momentum transfer is described by an exponential function with a slope parameter (5.2 ± 0.4) GeV^{-2}. The total cross section of the Φ-meson as well as its differential cross section for elastic scattering at the proton comes out too small by a factor of 0.6 to 0.7 and 0.5 relative to predictions of a combined vector-dominance-quark model. The trajectories of the forward-going K-mesons are recorded in proportional and spark chambers, a threshold Cherenkov counter discriminates against fast pions and electrons, the principle of track reconstruction out of spark coordinates are explained in detail. (DE)

31311 MEASUREMENT OF THE P-PARAMETER IN π^+p SCATTERING IN THE ENERGY REGION OF THE P_{33}-RESONANCE. Amsler, C. (High Energy Physics Lab., Villigen, Switzerland); Dubal, L.; Eaton, G. H.; Frosch, R.; Mango, S.; Pozar, F.; Rohrer, U. Lett. Nuovo Cim.; 15: No. 7, 209-213(14 Feb 1976).

Many π^+p differential and total cross sections were measured below T_π 300 MeV. Results for the parameter P and the phase shift analysis are also shown and discussed. (JFP)

31312 MULTIPLICITY OF SECONDARY PARTICLES IN π^- ^{12}C INTERACTIONS AT 4, 5, AND 40 GeV/c. Azimov, S. A.; Igamberdev, K. R.; Inogamov, Sh. V. (Physical-Technical Inst., Tashkent). Yad. Fiz.; 22: No. 6, 1168-1177(Dec 1975). (In Russian).

Propane bubble chambers are used to measure multiplicities of secondary charged particles in π^- ^{12}C interactions at 4; 5 and 40 GeV/c momenta. Multiplicity distributions of slow protons ($150 \lesssim p_p \lesssim 800$ MeV/c) coincide at those three energy values. The mean multiplicity of relativistic charge particles increases with energy as $\langle n_s \rangle = \alpha + \beta \ln s$. The correlations between $\langle n_s \rangle$ and n_p grow when the π^--meson energy increases. The ratio of mean multiplicities $\langle n_s \rangle$ of relativistic charged particles in π^- ^{12}C interactions at 40 and 5 GeV/c does not depend on the proton multiplicity. (auth)

31313 SOME CHARACTERISTICS OF THE INCLUSIVE PROCESS $\pi^- + p \rightarrow \pi^+ +$ ANYTHING IN THE FRAGMENTATION REGION OF INCIDENT PARTICLE AT 2.69 AND 3.25 GeV/c. Abramov, B. M.; Dukhovskoi, I. A.; Kishkurno, V. V.; Krutenkova, A. P.; Kulikov, V. V.; Radkevich, I. A.; Fedorets, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yad. Fiz.; 22: No. 6, 1178-1184(Dec 1975). (In Russian).

The inclusive cross section of the reaction $\pi^- + p \rightarrow \pi^+ +$ anything is measured in the fragmentation region of the incident particle at 2.69 and 3.25 GeV/c momenta. For $p_0 = 3.25$ GeV/c the invariant cross section $\rho(x, p_\perp^2)$ is presented as a function of the square of the transversal momentum $p_\perp^2$ for fixed intervals of Feynman variable x. It is found that for $0.6 \leq x \leq 0.94$ and $p_\perp^2 = 0.03$ (GeV/c)^2 the values of $\rho(x, p_\perp^2)$ at $p_0 = 2.69$ and 3.25 GeV/c coincide within the errors. The measured invariant cross section is compared with data at higher energies. It is shown that in contrast to the fragmentation region of the target, there is no scaling in the reaction studied up to $p_0 = 11$ to 16 GeV/c in the fragmentation region of the incident particle. If the invariant cross section is written in the form $\rho \sim \exp[-A(x)p_\perp^2]$, then the parameter $A(x)$ appears to be the same for $p_0 = 3.25$ and 16 GeV/c for $0.7 \leq x \leq 0.95$. (auth)

31314 PION PRODUCTION FROM NUCLEI BOMBARDED BY PROTONS OF 1, 2, AND 3 GeV. Edge, R. D. (Univ. of South Carolina, Columbia); Tompkins, D. H.; Glenn, J. W. Nuovo Cim., A; 31A: No. 4, 641-652(21 Feb 1976).

The differential production cross section for pions above 0.2 GeV/c was found for targets of Be, C, Cu and Pb bombarded by 1, 2 and 3 GeV protons at one or more of the angles 0, 17 and 32^0, using a magnetic spectrometer and time-of-flight telescope. The spectral shapes show some agreement with Monte Carlo calculations of Bertini. Isobar decay adequately explains the production cross section, except at 0^0. (auth)

31315 PION–NUCLEON SCATTERING AMPLITUDES FROM DATA AND FIXED-t ANALYTICITY. Hoehler, G. (Univ., Karlsruhe, Ger.). Czech. J. Phys.; B26: No. 1, 55-67(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

A summary of recent work of the Karlsruhe group on the determination of πN amplitudes at high energies from experimental data and fixed-t analyticity is given. (auth)

31316 SPIN-PARITY ANALYSIS OF THE $\pi^-\pi^+\pi^+$ SYSTEM PRODUCED COHERENTLY IN 4 GeV/c π^+d INTERACTIONS. Emms, M. J. (Univ. of Birmingham, Eng.); Jones, G. T.; Kinson, J. B. pp 29-31 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

A spin-parity analysis of the low mass 3π system produced in the reaction $\pi^+d \rightarrow \pi^-\pi^+\pi^+d$ was performed using data from an exposure of the CERN 2m bubble chamber to a π^+ beam of 4 GeV/c momentum. Unnatural parity states predominate, 1^+ being much more significant than 0^- and 2^+. The $J^P = 2^+$ contribution in the A_2 region was found to be (5 ± 2) %. (auth)

31317 MULTIPARTICLE SPECTROMETERS AND THEIR USE IN MESON SPECTROSCOPY. Cashmore, R. J. (Univ. of Oxford). pp 69-78 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

The recent use of multiparticle spectrometers in meson spectroscopy has made possible an increase in statistics of more than 10 times with good measurement resolution and also superior particle identification. Such use is demonstrated by the example of a 13-GeV/c K^+p scattering experiment carried out as SLAC. From this example it is shown that: acceptance problems are well defined and tractable; the increased statistics make the observation of smaller and smaller effects possible, e.g. the $2^+0^-\pi K^*$ wave; it is possible to look forward to a very detailed description of the Q region from this experiment (both in mass and t). (UK)

31318 PARTIAL WAVE ANALYSIS OF THE 3π SYSTEM IN THE REACTION $\pi^+d \rightarrow \pi^+\pi^-\pi^0pp_s$. Emms, M. J. (Univ. of Birmingham, Eng.); Jones, G. T.; Kinson, J. B. pp 117-118 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

Preliminary results for a partial wave analysis of the charge exchange reaction:- $\pi^+d \rightarrow \pi^+\pi^-\pi^0pp_s$, are presented. The data came from an exposure of the CERN 2m deuterium bubble chamber to a separated beam of 4 GeV/c π^+ mesons. The exposure of about 16 events per microbarn yields approximately 41,000 events best described by this reaction. (UK)

31319 EVIDENCE FOR DIFFERENT POLARIZATION OF THE $1^+S\ K^*\pi$ AND $1^+S\ K\rho$ SYSTEMS. Hansen, J. D. (Niels Bohr Inst., Copenhagen). pp 125-128 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

New results on the study of the Q-enhancement are presented using the reactions $K^-p \rightarrow K^-\pi^-\pi^+p \ldots$ (1) and $K^-p \rightarrow \bar{K}^0\pi^-\pi^0p \ldots$ (2). The data were obtained using a beam of 14.3 GeV/c kaons, the number of events in reactions (1) and (2) being 16000 and 4000, respectively. Two points concerning the 1^+S contribution to the Q-enhancement are discussed: (1) that the isospins of the $1^+S\ K^*(890)\pi$ and $1^+S\ K\rho$ systems are $\frac{1}{2}$. (2) that the $1^+S\ K^*(890)\pi$ and $1^+S\ K\rho$ systems are produced with different polarization i.e. they are not decay modes of a single Q. Evidence is presented for the existence of at least two Q-systems both with isospin $\frac{1}{2}$. Further the polarizations of the $1^+S\ K^*(890)\pi$ and $1^+S\ K\rho$ systems are found to be different such that $1^+S\ K^*(890)\pi$ approximately obeys t-channel helicity conservation and $1^+S\ K\rho$ S-channel helicity conservation. (UK)

31320 CONCLUSIONS AND OUTLOOK. Michael, C. (Univ. of Liverpool). pp 131-135 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

The papers presented at the Daresbury Study Weekend on three particle phase shift analysis and meson resonance production (1975) are reviewed. Techniques suggested and assumptions involved in extracting angular momentum information about three body systems are considered. The main application of these techniques lies in the extraction of resonance contributions and the resulting study of spectra, decay schemes and production mechanisms. The evidence presented at the meeting on the missing quark model states is summarized and some indications of fruitful future lines of attack are given. (UK)

31321 CROSS SECTIONS AND MULTIPLICITY DISTRIBUTIONS FOR π^-p INTERACTIONS AT 11.2 GeV/c. Forino, A. (Univ., Bologna); Gessarolia, R.; Quareni-Vignudelli, A. Nuovo Cim., 31A: No. 4, 696-704(21 Feb 1976).

Results are presented concerning topological cross sections and multiplicity distribution for a π^-p experiment at 11.2 GeV/c. The statistics used are one-half of the total ones (10^6 bubble chamber pictures). Comparison with data at different energies and theoretical predictions are made, and satisfactory agreement is obtained. (auth)

31322 PROPERTIES OF THE NEW PARTICLES psi(3095) AND psi'(3648). Abrams, G. S. (Univ. of California, Berkeley). pp 25-38 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

A review is presented of the analyses of the psi(3095) and psi'(3684) data by the SLAC-LBL SPEAR magnetic detector collaboration. Quantum number determinations are presented, as well as available information on decay modes.

31323 NEW PARTICLE SEARCHES AND DISCOVERIES AT SPEAR. Feldman, G. J. (Stanford Univ., CA). pp 39-54 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The discussion of new particles searches and discoveries at SPEAR include the search for nonleptonic decays of charmed particles, a study of radiative PSI' decays to new states, PSI' yields gamma chi, where the chi's are observed to decay into hadrons and into gamma PSI, evidence for anomalous lepton production, and limits on inclusive muon production. (JFP)

31324 psi(3095) AND psi(3684) RESULTS FROM THE HEPL EXPERIMENT AT SPEAR. Liberman, A. D. (Stanford Univ., CA). pp 55-68 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

A summary is given of what has been learned about the new particles from an apparatus used at SPEAR. Included are the psi (3095) and psi(3684) results, and monoenergetic photons from the decays of these psi particles. (JFP)

31325 RECENT RESULTS FROM DORIS. Wiik, B. H. (Deutsches Elektronen-Synchrotron, Hamburg). pp 69-96 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The present status of the accelerator and data obtained with the double arm spectrometer and the superconducting solenoid are discussed. Preliminary results on inclusive distributions, particle ratios, and limits on heavy charged mesons from the decays of the psi resonances, hadronic two-body decays of psi resonances, the cascade decay: PSI' yields (J/PSI) +X, evidence for narrow states P/sub c/ with even charge conjugation and masses between 3.7 and 3.1 GeV, two-photon final states, three-photon final states and evidence for a new resonance. (JFP)

31326 EXPERIMENTAL RESULTS OF e^+e^- ANNIHILATION AT ENERGIES OF 3 GeV AND LOWER. Bemporad, C. (Univ., Pisa, Italy). pp 113-130 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

New experimental results that have become available since 1973 are summarized. Adone results of the J/PSI, the search for other possible narrow resonances, proton form factors in the time-like region, phi radiative decays, and pion form factor in the time-like region near threshold are covered. (JFP)

31327 PRODUCTION OF NEW PARTICLES FROM PROTON–PROTON INTERACTIONS. Ting, S. C. C. (Massachusetts Inst. of Tech., Cambridge). pp 155-188 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The production of new particles from proton–proton interactions was studied in a high sensitivity experiment in which narrow width particles were detected over a wide mass region. A real massive particle J yields e^+e^- was observed having a width smaller than 5 MeV/c^2. The yield of J was found. (JFP)

31328 NEW PARTICLE PRODUCTION BY NEUTRONS. O'Halloran, T. (Univ. of Illinois, Urbana). pp 189-194 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

In an experiment measuring the reaction n + Be yields mu^+mu^- + anything, inclusive rho^0 and J(3100) and massive muon pair production were observed. One compares rho^0 and J^0(3100) production and compare the masive muon pair production to the Drell–Yan model. (auth)

31329 DIMUON PRODUCTION BY PIONS AND PROTONS. Weinstein, R. (Northeastern Univ., Boston). pp 195-205 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

Dimuon production is reported for the reaction pi^- + Fe yields $mu^+ + mu^-$ + anything at 200 GeV and p + Fe yields $mu^+ + mu^-$ anything at 240 GeV. The X/sub L/ identical with P/sub L//P/sub Beam/ and P/sub perpendicular/ dependences of psi production are parameterized and fitted. For X/sub L/ greater than or equal to 0.5, the ratio of the psi production cross section for pions in iron to that for protons is found to be 7.4 +- 2. For the intermediate mass region, 1.2 less than or equal to M less than or equal to 2.5 GeV, preliminary results are given for X/sub L/, P/sub perpendicular/ and M/sub mu mu/ dependences. (auth)

31330 PHOTOPRODUCTION OF psi, psi', AND A SEARCH FOR NEW PARTICLES AT SLAC. Prepost, R. (Univ. of Wisconsin, Madison). pp 241-253 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The discussion of photoproduction of the new particles covers limits on resonant dilepton production other than PSI, the SLAC-Wisconsin experiment gamma N yields PSI, PSI', and the inelastic cross section and limits on D production. (JFP)

31331 INCLUSIVE PRODUCTION OF CHARGED PIONS IN 200 GeV/c pi^-p INTERACTIONS. Fokitis, E. D. Notre Dame, IN; Univ. of Notre Dame (1976). 112p. University Microfilms Order No. 76-4612.

Thesis (Ph. D.).

pi^-p interactions have been studied experimentally at 200 GeV/c. Topological cross sections and multiplicity moments of this reaction have been presented. These features have been compared with data from other experiments. The dependence of inclusive pi/sup +-/ production cross sections on rapidity for this reaction are presented and compared with the data on pp collisions at the same energy. Some theoretical hypotheses, valid at asymptotically high energies, have been discussed in light of these high energy data. The production of positive and negative pions in single- and two-pion inclusive reactions has been studied in terms of current models of cluster production in high energy reactions. In single pi^- production, a strong leading particle effect is observed, which is associated with a significant production of leading clusters in high energy reactions. Two-particle inclusive reactions have been presented in terms of inclusive differential cross sections and correlations. Correlations of dynamic origin are found, when particles are in small rapidity separation. This is demonstrated by comparing the data with the expected correlations calculated from an independent particle emission model. The presence of these correlations supports the production of clusters in this energy range. The dependence of these correlations on energy and the type of colliding particles has been discussed using data on azimuthal correlations for two particles. These data have been compared with an independent cluster production model including Bose–Einstein statistics on the final state identical particles. This model reproduces the qualitative features observed in experiments, but cannot account for all the experimental features quantitatively. (Diss. Abstr. Int., B)

31332 STUDY OF ANGULAR CORRELATIONS IN DECAYS OF HEAVY MESONIC RESONANCES. Rechitskii, I. V.; Efrosinin, V. P.; Aynutdinov, M. S.; Danilov, M. V. (Moscow State Univ.). Yad. Fiz.; 23: No. 1, 110-122(Jan 1976). (In Russian).

Arguments are given in support of tending to coplanarity in decays of heavy resonances. The methodics of search for these correlations is described. Analyzing π^-p interactions at 5 GeV/c correlations were found which can be due to tending to coplanarity in decays of the resonance with ~1830-MeV mass. Possible ways are considered to estimate quantum characteristics of resonances when there is a strong tending to coplanarity in decays. Experimental possibilities of the methodics are shown by analyzing the features of the resonance supposed. (auth)

31333 $\pi^-p \to f^0n$ PROCESS AND THE OPTICAL MODEL. Guzhavin, V. M.; Garanina, T A.; Dubovikov, M. S.; Kliger, G. K.; Kolganov, V. Z.; Lebedev, A. V.; Lomkatsi, G. S.; Nilov, A. F.; Smolyankin, V. T. (Inst. of Theoretical and Experimental Physics, Moscow). Yad. Fiz.; 23: No. 1, 123-129(Jan 1976). (In Russian).

The experimental data are obtained on the production differential cross section and the elements of the density spin matrix of the f^0 meson in the reaction $\pi^-p \to f^0n$ (II) at 3.25; 4.5; 5.74 GeV/c initial momenta. The process (II) is described in the framework of the optical model at momenta higher than 4 GeV/c. It is shown that the optical model reflects the main features of the reaction (II). (auth)

31334 DETERMINATION OF PION–PION COLLISION CROSS SECTION FROM EXPERIMENTS ON π^-p INTERACTIONS AT 40 GeV/c MOMENTUM. Didenko, L. A.; Murzin, V. S.; Sarycheva, L. I. (Inst. of Nuclear Physics, Moscow). Yad. Fiz.; 23: No. 1, 130-135(Jan 1976). (In Russian)

The OPE events are selected by analyzing the experiments on π^-p interactions at 40 GeV/c momentum. The $\pi^-\pi^0$ interaction cross section is estimated in 2.5 to 4 GeV range of energies in the c.m. system of colliding particles. The obtained value $\sigma_{\pi^-\pi^0} = (8.5 \pm 3)$ mb coincides within the errors with the cross section measured at the energy of 0.4 to 0.5 GeV. (auth)

31335 SEARCH FOR THE DECAYS $\eta^0 \to \pi^0e^+e^-$ AND $X^0 \to \pi^0e^+e^-$. Martynov, A. S.; Saltykov, A. I.; Tarasov, A. V.; Uzhinskii, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 23: No. 1, 93-99(Jan 1976). (In Russian)

On films obtained in 30-1 Xe chamber of HEL at JINR exposed to the π^+ beam with $p_{\pi^+} = 2.34$ GeV/c the search was carried out for the decays η^0, $X^0 \to \pi^0e^+e^-$ in order to detect the effect of the C-invariance violation in strong or electromagnetic interactions of hadrons. In the total scope of 1.30×10^5 events of the (π^+–Xe) interactions no event compatible with the decay η^0, $X^0 \to \pi^0e^+e^-$ was detected. Assuming the Poisson distribution, on the 90% confidence level the upper estimate is obtained for the relative probability of the decay η^0, $X^0 \to \pi^0e^+e^-$. (auth)

31336 RECENT RESULTS ON THE 3.1 AND 3.7 GeV RESONANCES FROM THE DESY STORAGE RING. Braunschweig, W.; Jordan, C. L.; Martyn, U.; Sander, H. G.; Schmitz, D.; Sturm, W.; Wallraff, W. (Technische Hochschule Aachen (F. R. Germany). 1. Physikalisches Inst.); Berkelman, K.; Cords, D.; Felst, R. pp 37-42 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

The 3.1 and 3.7 GeV resonances have been studied with double

arm spectrometer DASP. Limits for radiative decays are given. The absence of a $\gamma\gamma$ decay supports the spin J = 1 assignment. No $\pi^+\pi^-$ decay of the 3.1 GeV resonance has been observed. This is strong evidence for I = 0. Inclusive hadron distributions and K/π, p/π ratios are studied. Preliminary results on the cascade decay of the 3.7 GeV resonance are presented. (FR)

31337 STUDY OF $\psi(3.1)$ AT SPEAR. Augustin, J. E.; Boyarski, A. M.; Breidenbach, M.; Bulos, F.; Dakin, J. T.; Feldman, G. J.; Fischer, G. E.; Fryberger, D.; Hanson, G.; Larsen, R. R. (Stanford Linear Accelerator Center, Calif. (USA)). pp 1-16 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

A very sharp peak is observed in e^+e^- annihilation at 3.095 ± 0.005 GeV. The total width is $\gamma = 77 \pm 19$ keV. Lepton pair angular distribution and interference effects with electrodynamic lepton pairs production support a spin parity assignment 1^- for $\psi(3.1)$. Comparison of the relative abundance of exclusive multipion final states on and below the resonance suggests a negative G parity and an isospin zero. (FR)

31338 SOME PROPERTIES OF THE $\psi(3.7)$ RESONANCE, AND FEATURES OF THE TOTAL HADRONIC CROSS SECTION IN e^+e^- ANNIHILATION FROM 2.4 GeV TO 5.0 GeV c.m. ENERGY. Abrams, G. S.; Briggs, D. D.; Chinowsky, W.; Friedberg, C. E.; Goldhaber, G.; Hollebeek, R. J.; Litke, A.; Lulu, B. A.; Pierre, F.; Sadoulet, B. (California Univ., Berkeley (USA). Dept. of Physics; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 17-35 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

An analysis of data at the $\psi(3.7)$ resonance gives a partial width to electrons $\gamma(e) = 2.2 \pm 0.5$ keV, and limits on total width 200 keV $< \gamma <$ 800 keV. The decay $\psi(3.7) \to \psi(3.1)\pi^+\pi^-$ is observed with a branching ratio 0.31 ± 0.04, and $\psi(3.7) \to \psi(3.1)$ + anything has a branching ratio of 0.54 ± 0.08. The ψ resonances appear to have the same G-parity. An enhancement occurs in the total hadronic cross section at a c.m. energy of about 4.1 GeV, rising to about 32nb from a level of 18nb adjacent to peak, which is about 300 MeV wide. The integrated cross section for the peak is about 5.5nb-GeV, comparable to that for the $\psi(3.7)$ and $\psi(3.1)$ resonances. (FR)

31339 OBSERVATION OF S^* PRODUCTION AT 1.98 GeV/c. Buttram, M.; Crawley, H.B.; Duke, D.W.; Lamb, R.C.; Leeper, R.J.; Peterson, F.C. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. D 13: No. 5, 1153-1160 (1 Mar 1976).

We have studied the S^* meson using data from the reactions $\pi^-p \to \pi^+\pi^-n$ and $\pi^-p \to K^+K^-$ at 1980 MeV/c. The parameters of the S^* pole were found by fitting the dimeson mass spectra from these reactions to a Briet-Wigner resonance formula with a coherent background. The dimeson mass was calculated from the beam and neutron four-vectors, the latter being measured by a time-of-flight technique. The mass resolution is $\sigma = 4$ MeV/c^2. Dimeson production was identified by analyzing the final-state meson trajectories with a magnetostrictive wire spark-chamber spectrometer. The events in our data sample were required to have a slow forward-going neutron which restricted the allowed range of four-momentum transfer to $|t - t_{min}| < 0.003$ (GeV/c)^2 in the S^* region. From a simple of 21 700 $\pi^+\pi^-n$ events and 52 K^+K^-n events, we find the position of the S^* pole to be $(970 \pm 5) - i\,(22 \pm 5)$ MeV/c^2 as compared to the present world average value of $(993 \pm 4) - i\,(20 \pm 4)$ MeV/c^2. (auth)

31340 SEARCH FOR A DIFFERENCE BETWEEN THE STRANGE AND NONSTRANGE QUARKS OF THE K^+ MESON. Erwin, A.R.; Harvey, E.H.; Loveless, R.J.; Thompson, M.A.; Winn, D.R. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706); Barnes, V.E.; Carmony, D.D.; Christian, R.S.; Garfinkel, A.F.; Morse, W.M.; Rangan, L.K. Phys. Rev. Lett. 36: No. 12, 636-639 (22 Mar 1976).

A tendency for the π^- to peak at small negative rapidity in the center-of-mass system for the reaction $K^+ + p \to \pi^- + X$ at 100 GeV may be related to a difference in the momentum spectra for the strange quark and the nonstrange quark in the K^+ meson, as may anomalies in the average multiplicity of charged particles and in the p_T^{max} of events as a function of π^- rapidity. (auth)

31341 OBSERVATION OF TWO STRANGENESS-ONE AXIAL-VECTOR MESONS. Brandenburg, G.W.; Carnegie, R.K.; Cashmore, R.J.; Davier, M.; Dunwoodie, W.M.; Lasinski, T.A.; Leith, D.W.G.S.; Matthews, J.A.J.; Walden, P.; Williams, S.H.; Winkelmann, F.C. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 36: No. 13, 703-706 (29 Mar 1976).

We present a partial-wave analysis of the $K^+\pi^+\pi^-$ system in $K^+p \to K^+\pi^+\pi^-p$ at 13 GeV. Evidence is given for the existence of two $J^P = 1^+$ mesons: one at ~1300 MeV($\Gamma \sim 200$ MeV) coupling principally to ρK and the other at ~1400 MeV ($\Gamma \sim 160$ MeV) coupling principally to $K^*\pi$. (auth)

31342 PRODUCTION PROPERTIES OF Q MESONS IN $K^+p \to K^+\pi^+\pi^-p$ AT 13 GeV. Brandenburg, G.W.; Carnegie, R.K.; Cashmore, R.J.; Davier, M.; Dunwoodie, W.M.; Lasinski, T.A.; Leith, D.W.G.S.; Matthews, J.A.J.; Walden, P.; Williams, S.H.; Winkelmann, F.C. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 36: No. 13, 706-709 (29 Mar 1976).

The momentum transfer (t') dependence of the $J^P = 1^+$ $K^*\pi$ and pK partial waves in the $K^+\pi^+\pi^-$ system is presented. The production of the Q_1 meson ($m \sim 1300$ MeV), which has a large ρK decay mode, obeys approximate s-channel helicity conservation. In contrast the production of the Q_2 meson ($m \sim 1400$ MeV), which decays predominantly to $K^*\pi$, statisfies approximate t-channel helicity conservation. Furthermore the Q_1^+ production distributions are virtually identical, whereas the Q_2^+ distributions exhibit a distinct crossover for $|t| \sim 0.18$ GeV^2. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 31229, 31230, 32055, 32056, 32069, and 32140.

31343 (IPNO-TH-75-30) PION NUCLEON VERTEX FUNCTION AND THE ONE PION EXCHANGE POTENTIAL. Nutt, W.; Loiseau, B. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). 1975. 22p. INIS.

The πNN vertex function is calculated from field theory and dispersion relations. It contains no adjustable parameters, the only input being S- and P-wave for $\pi\pi \to$ N anti-N. This vertex function, having an effective cut-off mass of 5μ and a r.m.s. radius of 52fm, compares well with previous experimental determinations. The effects from the 3π dressing of the π propagator are found to be negligible. The correlated OPEP is significantly different from the uncorrected one-pion exchange potential (OPEP) for r < 1.5 fm. The inclusion of the corrected OPEP in meson exchange potentials will improve agreement with phenomenology. (FR)

31344 QUARK-POLARON MODEL OF FUNDAMENTAL PARTICLES. Iwao, S. (Kanazawa Univ., Japan). Lett. Nuovo Cim.; 15: No. 10, 331-336(6 Mar 1976).

It is confirmed that the magnetic moments of baryons in $(qq)_{sym}q$ composite in SU(3) symmetry may be explained in terms of effective quark magnetic moments consistently with the experimental values and the quark masses utilized in hadron spectroscopy. An additional supporting evidence of the phenomenology is obtained from the charge radius of quarks estimated from the quark form factor derived from the proton structure functions. Secondly, it is explained that the quark masses and their ratios predicted by the chiral algebra may represent the quantities for free quarks so that the effective quark masses are caused by polaronlike behavior of quark states in a hadron box. It is considered that such an idea is supported by the results of hadron spectroscopy and asymptotic freedom. Finally, it is pointed out that the smallness of the observed single-photon associated decay widths among charmonium states and those for new to ordinary mesons may also be explained by a similar idea. A speculation is made on the total hadron-hadron cross section at asymptotic energies. (JFP)

31345 INCONSISTENCY BETWEEN GROWING MULTIPLICITY OF CLUSTERS AND THE DATA ON σ_{el}/σ_{tot} IN THE UNCORRELATED-CLUSTER MODELS. Anselmino, M.; Ballestrero, A. (Univ., Turin). Lett. Nuovo Cim.; 15: No. 10, 329-330(6 Mar 1976).

In previously proposed cluster models it is usually assumed that clusters are practically uncorrelated in the central region and that their mean number grows with energy. It is shown that the two previous assumptions are inconsistent if the ratio σ_{el}/σ_{tot} does not tend asymtotically to zero (as present experiments seem to indicate). (JFP)

31346 SIMPLE BOOTSTRAP MODEL FOR THE MULTIPLICITY DISTRIBUTIONS. Tataru-Mihai, P. I. Lett. Nuovo Cim.; 15: No. 7, 240-244(14 Feb 1976).

A new bootstrap model is presented for the multiplicity distri-

bution functions. The model is based on the dual unitarity scheme. A qualitative discussion is presented for a given bootstrap equation. (JFP)

31347 RELATIVISTIC DYNAMICS FOR THE SPIN ½ PARTICLE. Horwitz, L. P. (Tel-Aviv Univ., Israel); Piron, C.; Reuse, F. *Helv. Phys. Acta*; 48: No. 4, 546-548(1975).

A model for a relativistic spin ½ particle is formulated in terms of a 14 parameter group. (SDF)

31348 PRODUCTION OF Ψ/J PARTICLES IN REACTIONS OF THE CHARGE-EXCHANGE TYPE. Prokoshkin, Yu.D. (Institute of High Energy Physics). JETP Lett. 22: No. 6, 156-156 (20 Sept 1975).

It is shown that the cross section for the production of particles in reactions of the charge-exchange type is strongly suppressed, as follows from the experimental data, in comparison with the cross section for the production of particles consisting of p and n quarks. This offers evidence in favor of the structure $\Psi = (c\bar{c})$. (auth)

31349 MASSES OF CHARMED MESONS AND *SU* (8) SYMMETRY. Khrushchev, V.V. (Institute of High Energy Physics). JETP Lett. 22: No. 6, 165-166 (20 Sept 1975).

The group *SU* (8), which combines *SU* (4) and *SU* (2) spin, is considered as an expanded hadron symmetry group. The possible masses of the D, F, D^*, and F^* mesons are calculated on the basis of the derived mass relations. (auth)

31350 ONE-BODY SPECTRA OF GENERATION OF EXCITED STATES IN THE DUAL RESONANCE MODEL. Gedalin, E. V.; Gurvich, E. G. (Inst. of Physics, Tbilisi, USSR). Yad. Fiz.; 22: No. 6, 1217-1224(Dec 1975). (In Russian).

One-body spectra of production of transversal states in the dual resonance model in the fragmentation and three-reggeon limit models are considered. It is shown that in this region the inclusive distribution decreases with increase of the mass and spin of the excited state. (auth)

31351 RELATION BETWEEN STATISTICAL MASS SPECTRUM AND S-MATRIX EIGENPHASES. Fre, P. (Univ., Turin); Sertorio, L. Nuovo Cim., 31A: No. 2, 365-380(21 Jan 1976).

Two separate objects are counted; on one side the masses entering into the statistical-mechanics mass spectrum, on the other side the eigenvalues of the S-matrix, which under certain circumstances can be approximated by resonances. The connection existing between these two types of counting is discussed. (auth)

31352 BOUNDS ON THE ELASTIC SCATTERING AMPLITUDE AT FINITE ENERGIES. Vernov, Yu. S. (Inst. for Nuclear Research, Moscow); Mnatsakanova, M. N. Czech. J. Phys.; B26: No. 1, 105-112(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

A bound on the ratio of differential cross sections of particle and antiparticle at finite energies was derived using the relation between phase and modulus of the scattering amplitude which follows from analyticity, unitarity, and crossing symmetry. (auth)

31353 HIGGS MODEL AND SUPERSYMMETRY. Fayet, P. (Laboratoire de Physique Theorique de l'Ecole Normale Superieure, Paris). Nuovo Cim., 31A: No. 4, 626-640(21 Feb 1976).

The Higgs model can be made supersymmetric, provided a Dirac spinor is added, and the quartic interaction term in the Lagrangian density is $-(e^2/2)(\varphi^+\varphi)^2$, where e is the gauge coupling constant. The model describes a vector, a Dirac spinor and a real scalar; it depends only on two arbitrary parameters, m and e. As a gauge-invariant model, it can be studied in a Wess-Zumino gauge or in a sypersymmetric gauge. It can also be obtained as a theory of a self-interacting vector multiplet. Finally, it is suggested that a scalar particle may be associated with the photon and the two neutrinos in the theory of weak and electromagnetic interactions. (auth)

31354 SEQUENTIAL DECAY OF ANISOTROPIC FIREBALLS. Bassetto, A. (Libera Univ., Trento, Italy); Lausanna, L.; Toller, M. Nuovo Cim., 31A: No. 2, 305-320(21 Jan 1976).

A class of models for many-particle production which are based on the sequential decay of fireballs with a strongly anisotropic distribution of the decay products is studied. Using an exact kinematical formalism, expressions for physically interesting distributions are derived in terms of the solution of a basic integral equation which contains a convolution over the Lorentz group. Then one proposes a useful approximate treatment based on the replacement of $SL_{2,C}$ by its contraction $E_{2,C}$ justified by the limitation of the transverse momenta. A class of representations of this group are described, and used for the harmonic analysis of the basic equations of the model. (auth)

31355 SOURCES OF INCOHERENCE IN 3-BODY PARTIAL WAVE ANALYSIS. Cashmore, R. J. (Univ. of Oxford). pp 15-18 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

All the sources of incoherence that can occur in the analysis of 3-particle states in production experiments are defined. In each case a model reaction is presented and the density matrix and amplitude analysis approaches considered. It is shown that there are many potential sources of incoherence that are usually identified by poor fits and/or increase in the rank of the density matrix. However once identified the sources can in general be explicitly demonstrated in the fitting amplitudes and many of the problems removed. (UK)

31356 RE-ARRANGEMENT EFFECTS IN THREE-BODY FINAL STATES. Morgan, D. (Rutherford Lab., Chilton, Eng.). pp 97 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

The question of rescattering corrections in the discussion and interpretation of isobar analysis of production processes, is discussed. Whether the apparent phase behavior of three-body resonances will be modified by re-arrangement collisions in the final state and whether this is significant is considered. A scheme is proposed for estimating these effects, on the lines of the Khuri-Treiman approximation, but with the integrations confined to the physical Dalitz plot. (UK)

31357 PHOTON-PHOTON SCATTERING CONTRIBUTION TO THE ANOMALOUS MAGNETIC MOMENT OF THE MUON. Samuel, M.A. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Chlouber, C. Phys. Rev. Lett. 36: No. 8, 442-446 (23 Feb 1976).

A careful and systematic recomputation of the photon-photon scattering contribution to the muon magnetic-moment anomaly is made. The result is $\Delta a_{\text{ph-ph}} = (21.32 \pm 0.05)(\alpha/\pi)^3$ leading to the theoretical value $a_\mu{}^{\text{th}} = (1165918 \pm 10) \times 10^{-9}$. (auth)

31358 CHARGE SCREENING AND MASS SPECTRUM. Swieca, J.A. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. D 13: No. 2, 312-314 (15 Jan 1976).

A general connection between the existence of charge sectors and the mass spectrum is established in Abelian gauge theories in a space-time of dimension larger than two. The exceptional role of two-dimensional space-time is related to Coleman's "quantum soliton." (auth)

31359 ZEROS OF THE MULTIPARTICLE GENERATING FUNCTION IN HADRONIC SCATTERING MODELS. Hendrick, R.E. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 13: No. 2, 315-328 (15 Jan 1976).

Feynman and Wilson have proposed an analogy between the physics of multiparticle production and the description of a gas of molecules in statistical mechanics. The zeros of the grand partition function are known to play an essential role in the thermodynamic description of a gas. Motivated by the Feynman-Wilson gas analogy, Khuri has recently shown that the zeros of the multiparticle generating function play an equally important role in hadronic scattering. In particular, Khuri has shown that hadronic theories satisfying unitarity and the Froissart bound and having a nonshrinking nearest zero of the multiparticle generating function will have an improved Froissart bound on the total hadronic cross section. The improvement of the bound resulting from a nonshrinking nearest zero is essentially from $[\ln(s/s_0)]^2$ to $\ln(s/s_0)$. This work applies a number of mathematical techniques of statistical mechanics to study the behavior of the nearest zero of the multiparticle generating function in a general class of hadronic production models. Sufficient conditions are found which control the shrinkage of the nearest zero in production models with general, multibody interactions. The reduction of the conditions to the simpler case of two-body interactions and the physical interpretation of the sufficient conditions are discussed. Multiperipheral models are shown to be a small subclass of the two-body interaction models. (auth)

31360 HAMILTONIAN FORMULATION OF MONOPOLE THEORIES WITH STRINGS. Balachandran, A.P.; Ramachandran, R.; Schechter, J.; Wali, K.C. (Department of Physics, Syracuse University, Syracuse, New York); Rupertsberger, H. Phys. Rev. D 13: No. 2, 354-360 (15 Jan 1976).

We consider the Hamiltonian formulation of the theory resulting from Dirac's monopole action supplemented by a mass term for the gauge field. The original (zero-mass gauge field) theory is also discussed and its Hamiltonian is shown to be essentially the same as that of the two-potential formalism. In this case, the coordinates of the string are

absorbed into what turn out to be the physically meaningful variables for the particles and the field. In the massive case, the string does play a significant role and gives rise to a static linear potential and a Yukawa potential between the monopoles. Such a potential has also been found by Nambu and others and may lead to an acceptable model for interactions of quarks. (auth)

31361 STRINGS, MONOPOLES, AND MESON STATES. Balachandran, A.P.; Ramachandran, R.; Schechter, J.; Wali, K.C. (Department of Physics, Syracuse University, Syracuse, New York); Rupertsberger, H. Phys. Rev. D 13: No. 2, 361-368 (15 Jan 1976).

Dirac's formulation of the monopole theory modified by an additional mass term for the gauge field has been considered as a possible simplified model for quark binding. We discuss methods for the consistent regularization of the infinities present in the resulting action and equations of motion. In this way we are led to an action which is the same as that suggested by previous authors. We show that the expression for the energy of the modified action still has infinities unless the mass of the gauge field is infinite. Thus the regularization procedure is incomplete when the gauge field has finite mass. Applications of the regularized model to charmonium and other meson states are discussed. (auth)

31362 QUARK SELF-ENERGY. Stuller, R.L. (Physics Department, Imperial College, London SW7 2BZ, England). Phys. Rev. D 13: No. 2, 513-522 (15 Jan 1976).

A model of colored quarks interacting through non-Abelian vector gauge potentials is analyzed. An analogy with the Kondo effect of solid-state physics is exploited to suggest approximations to the coupled integral equations for the quark field two-point function. Conditions are described for which the *self-consistently* determined quark mass equals infinity. A covariant bound-state equation for color singlet mesons is derived which is essentially *three*-dimensional. The internal Minkowski space, parametrized by the relative coordinate four-vector x^μ, is replaced by a hyperplane in that space defined by $x^\mu P_\mu = 0$, P^μ being the four-momentum of the meson. Thus, "quark confinement" to the "inside" of the meson induces a contraction of the four-dimensional, internal Minkowski space to that hypersurface orthogonal to P^μ. Some peculiarities of the equation are briefly discussed. (auth)

31363 FOKKER ACTION PRINCIPLES WITH SELF-ACTION. I. General Theory: Outline of a Program for Constructing Models of Elementary Particles. Schild, A. (Univ. of Texas, Austin). Ann. Phys. (N. Y.); 93: No. 1-2, 88-115(5 Sep 1975).

Fokker action principles with self-action are studied. A program is outlined that offers long-odds hope for the construction of classical models of some elementary particles. An outline is given of the general theory, its possibilities and its difficulties. Applications are given of the theory to circular motions of a single particle interacting with itself. A specific, but ugly, model that arose in a thus-far unsuccessful attempt at a theory of the electron is discussed. (auth)

31364 ULTRAVIOLET AND INFRARED INTERACTIONS OF THE QUANTIZED FIELD. Polyakov, A. M. (Inst. for Theoretical Physics, Moscow). pp 855-866 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

Small and large distance properties of particle interactions in quantum field theory are considered using infrared and ultraviolet colors in an attempt to draw a whole picture. Deep inelastic scattering, electron--positron annihilation into hadrons, electromagnetic form factors, large-angle scattering, other processes, and also properties of the effective interaction: freedom, confinement, and scaling including two-dimensional massless fermions with self-interaction or one-dimensional model and the two-dimensional chiral Lagrangian or the two-dimensional isotropic ferromagnet are discussed. (JFP)

31365 QUARK CONFINEMENT. Dashen, R. (Los Alamos Scientific Lab., NM). pp 981-986 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

A short qualitative review of quark confinement and recent progress in field theory is given.

31366 QUANTUM STATISTICS OF SCALAR MASSLESS PARTICLES. Chernikova, E. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 59-66(1975). (In Russian).

31367 ALGEBRAIC APPROACH TO THE QUARK PROBLEM. Casalbuoni, R.; Domokos, C.; Kovesi-Domokos, S. (Johns Hopkins Univ., Baltimore). Nuovo Cim., A; 31A: No. 3, 423-446 (1 Feb 1975).

An algebraic framework is constructed for the description of color singlet states composed of colored quarks. Quark fields are elements of a local octonionic module. Invariant actions are constructed for the quark fields. The actions are symmetric under local color transformations belonging to the exceptional Lie group G_2. The theory is quantized in a generalized path integral formalism. It is found that only color singlet states propagate, whereas quarks are confined. (auth)

31368 POSSIBLE TIME CHANGES IN FUNDAMENTAL CONSTANTS. Kalinin, M. I.; Mel'nikov, V. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 70-82(1975). (In Russian).

31369 STATISTICAL MODEL OF DECAY OF RESONANT STATES. Dubovikov, M. S. (Moscow Physical-Technical Inst.). Yad. Fiz.; 23: No. 1, 218-229(Jan 1976). (In Russian)

A model which is an alternative of Hagedorn–Frautshi statistical compound resonance model is formulated. The resonances in that model are elementary particles with their decay dynamics being symmetrical (an average symmetry is meant) with respect to produced particles. The postulated kind of the symmetry of the decay dynamics yields an exponential formula, involving only one unknown parameter α_0, for the mass spectrum of resonances. For $1/\alpha_0 = 140$ MeV the actual mass spectrum of resonances is qualitatively shown. Similar and different features of Hagedorn–Frauchi model and the proposed one are discussed. (auth)

31370 TRENDS IN HIGH ENERGY PHYSICS. Pandit, L. K. (Tata Inst. of Fundamental Research, Bombay (India)). Phys. News; 5: No. 4, 119-124(Dec 1974).

An outline of the trends in high energy physics in recent years is presented based on the proceedings of the XVIIth International Conference on High Energy Physics held in July 1974 at London. The developments that have taken place since the time of the previous conference (Chicago, 1972) have been discussed in detail. Notable among these are: new results on total cross sections ($200 \leq s \leq 3000$ Gev^2: FNAL-ISR) geometrical scaling, large angle scattering and lepton production and multiparticle production from the studies on hadron-hadron collisions. The theory of quantum electrodynamics has been tested from studies on lepton processes. In the study of the scaling behavior in e^+e^- colliding beams, the theory and experiment are very much in disagreement. The search for a unified field theory of weak, electromagnetic and strong interactions is being continued. Developments in the Langrangian field theory are reported. "Charm particles" and color octets have been postulated out of the quark family. Parton and bag models of hadrons are discussed. A new symmetry called "super symmetry" formulated recently is mentioned. (AK)

31371 A FUNDAMENTAL LENGTH AND MASSES OF STABLE ELEMENTARY PARTICLES. Sivaram, C.; Sinha, K. P. (Indian Inst. of Science, Bangalore. Dept. of Physics). Phys. News; 5: No. 4, 146-147(Dec 1974).

Some interesting relations connecting the fundamental constant of length, the coupling constants of the four fundamental interactions and the rest masses of stable particles such as proton or electron are pointed out. This relationship is of considerable importance in determining the rest mass of the neutrino. (AK)

31372 NEW PERSPECTIVES IN PARTICLE PHYSICS. Smith-Haenni, A. L. S. Afr. J. Sci.; 71: 133-134(May 1975).

Events in elementary particle physics are reviewed. The author starts with the 18th High-Energy Conference where the production of muon pairs in some high-energy neutrino experiments were mentioned. He then discusses the discovery of ψ s, speculations about "charm," interactions between protons and neutrons, "intermediate" vector bosons, quarks, "partons" and "gluons."

31373 *STOCHASTIC PROCESSES AND MULTIHADRON* PRODUCTION. Montvay, I. (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 38: No. 4, 313-319 (1975).

In the statistical bootstrap model [1–2] the decay of a fireball is well approximated by a linear chain when the fireball emits the hadrons subsequently (one by one). During the chain decay the fireball state performs a random walk in phase space. This stochastic process is described by a set of integral equations determining the hadron distribution [3]. In the next Section we consider these integral equations in a general stochastic framework which is the basis also for the quark model of hadron clusters [4–5]. Some general properties of the hadron distribution will be derived. In Section III some predictions of the

stochastic quark model of hadron clusters are reviewed and compared with experimental data. The question of the cluster distribution is also briefly considered in the quark model. This leads to multiple hadron clusters emitted by quarks.

31374 RELATION BETWEEN WAVE FUNCTIONS OF PARTICLES IN QUANTIZED AND CLASSICAL ELECTROMAGNETIC WAVES. Kazakov, A. E. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 27-32[1975]. (In Russian).

The relations between the wave functions of particles in a magnetic field being propagated along its electromagnetic waves was examined for a classical and quantized description of the electromagnetic waves. It was shown that the construction of a coherent combination of wave functions in the quantized waves makes it possible after passing the determined boundary transition to obtain wave functions of particles in classical waves. (tr-auth)

31375 PROBABILISTIC MODELS FOR THE PROCESSES OF MULTIPARTICLE PRODUCTION. Majernik, V. (Katedra Fyziky Pedagogickej Fakulty, Nitra (Czechoslovakia)). Acta Phys. Slovaca; 24: No. 4, 32-238(1974).

From triangle meeting on weak interactions; Smolenice, Czechoslovakia (4 Jun 1973).

Models of multiparticle production which mainly apply probabilistic arguments are dealt with. Stationary and nonstationary Markov models are described. (auth)

31376 LIFETIMES OF SU(3) GROUPS AND ψ PARTICLES AS A SCALING IN POWERS OF α. Mac Gregor, M.H. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. D 13: No. 3, 574-590 (1 Feb 1976).

A study of the experimental systematics of elementary-particle lifetimes leads to the following conclusions: (a) Elementary-particle lifetimes τ divide empirically into two distinct groups—"particles" ($\tau > 10^{-21}$ sec) and "resonances" ($\tau < 10^{-22}$ sec), where "particle" lifetimes are spaced by powers of $\alpha = e^2/\hbar c$ and "resonance" lifetimes occur as a continuum of values; (b) the scaling of "particle" lifetimes in powers of α is a "lifetime democracy" in the sense that baryons, mesons, and leptons, are all grouped together in one over-all lifetime scaling pattern; (c) integral-spin boson "particle" lifetimes scale in powers of α, whereas half-integral-spin fermion "particle" lifetimes scale in powers of α^2; (d) an SU(3) grouping of lifetimes reveals some striking patterns, with the ψ and ψ' lifetimes appearing as an extension of one of these patterns; (e) phase-space corrections, which are important for "resonance" lifetimes, are not as important for "particle" lifetimes; (f) if hadron lifetimes are grouped according to baryon number and strangeness, and then sorted into spin states, an empirical spin and lifetime correlation is seen in all of these groups: As the spin value increases, the maximum observed lifetime decreases. (auth)

31377 PARTICLE PRODUCTION AT LARGE TRANSVERSE MOMENTA: A PARTON-FREE APPROACH. Teper, M. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). Phys. Rev. D 13: No. 3, 629-638 (1 Feb 1976).

The multiperipheral picture for low-p_t particle production is extended to events containing a large-p_t hadron (with $x_t = 2p_t/s^{1/2} \lesssim 0.4$). Predictions are made for particle ratios, and scaling properties of the inclusive spectrum are derived. A speculative extension of the model to higher x_t is briefly described, and predictions are compared with the data. (auth)

31378 BARYON-EXCHANGE FORCES IN SU(4) SYMMETRY. Campbell, G. Jr. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 13: No. 3, 662-667 (1 Feb 1976).

The SU(4) -invariant trilinear Yukawa-type interaction Lagrangian is derived in terms of the mixing parameter. The SU(4) crossing matrix is given; the single-baryon–exchange forces classified according to exact SU(4) irreducible representations are calculated, discussed, and compared with the SU(3) baryon-exchange forces; and the value of the mixing parameter is evaluated by the reciprocal bootstrap method. The preliminary results indicate that an SU(4) bootstrap model may yield a better mass spectrum for the charmless resonances than is obtained with SU(3) bootstrap models. (auth)

31379 MODELS WITH MORE THAN FOUR QUARKS. Barnett, R.M. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 13: No. 3, 671-679 (1 Feb 1976).

Several models with more than four quarks are reviewed and compared with the four-quark model. They generally have right- and left-handed currents and are of the $SU_2 \times U_1$ type. The lepton sectors are also discussed including the possibilities of heavy charged and neutral leptons. The weak phenomenology, triangle anomalies, degenerate quark masses, and radial excitations are examined. (auth)

31380 APPROXIMATION TO FEYNMAN AMPLITUDES VALID FOR SMALL MASSES. Talman, R. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). Phys. Rev. D 13: No. 3, 688-696 (1 Feb 1976).

A simple procedure is given for exploiting the smallness of the electron mass in approximating Feynman amplitudes. Using helicity conservation, the Dirac matrices are factored out leaving amplitudes no more complicated than those for spinless particles. For the case of bremsstrahlung the helicity structure is exhibited and the validity of helicity conservation is studied. To exhibit the simplicity and power of the method an amplitude for trident production is written down by inspection. It is shown to agree with the value obtained by Bjorken and Chen using projection operators and traces. (auth)

31381 MASS FORMULAS FOR ψ PARTICLES. Terazawa, H. (Institute for Nuclear Study, University of Tokyo, Tanashi City, Tokyo 188, Japan). Phys. Rev. D 13: No. 3, 760-763 (1 Feb 1976).

Five classes of mass formulas in a color-quark model for ψ particles are presented. They include SU(3) and $SU(3)_c$ mass sum rules, $SU(3) \times SU(3)_c$ mass proportionalities and reciprocities, and $1 + F_c^2$ mass relations. All the formulas that can be checked experimentally are satisfied within experimental errors of less than 2%. A unified mass formula is also proposed which explains the masses of ψ particles unambiguously and which predicts those of yet undiscovered color-octet vector mesons. (auth)

31382 SINGLE-VARIABLE DESCRIPTION OF INCLUSIVE SPECTRA. Białas, A. (Max Planck Institut für Physik und Astrophysik, München, Germany); Stodolsky, L. Phys. Rev. D 13: No. 5, 1199-1202 (1 Mar 1976).

An "equivalent-quantum" picture of a high-energy hadron suggests that inclusive secondary spectra may be functions of only a single variable: $Q^2 = (Mx)^2 + K_T^2$. This appears to be true for proton-induced reactions, with $M^2 \simeq 5$ GeV^2. (auth)

31383 UNIFIED GAUGE MODEL FOR ELECTROMAGNETIC, WEAK, AND DIRECT LEPTON-QUARK INTERACTIONS. Soni, A. (The Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794). Phys. Rev. D 13: No. 5, 1268-1275 (1 Mar 1976).

A gauge model unifying weak and electromagnetic interactions and the so-called anomalous or direct interactions between leptons and quarks is discussed. The theory involves six leptons ν_e, ν_μ, e^-, μ^-, E^0, M^0, and six quarks N^0, λ^0, p^+, g^+, c^+, t^0 which are arranged in irreducible representations of the gauge group $G_{lh} = SU(2)_L \times SU(2)_R \times U(1)$ in such a way that spin-one fields that carry exotic quantum numbers also carry electrical charge. The theory is free of Adler-Bell-Jackiw anomalies. To give masses to six out of the seven gauge fields of G_{lh} and also to leave the ν_e, ν_μ massless while providing mass to ξ^0, H^0 through the Higgs-Kibble mechanism, two scalar doublets and a scalar (2×2) multiplet are introduced. Lepton number and baryon number are separately conserved. In the presence of neutral heavy leptons conventional lepton-hadron universality is maintained through a Cabibbo-type rotation $(\nu_e \sin\beta + E^0 \cos\beta)_L$, $(\nu_\mu \sin\beta + M^0 \cos\beta)_L$, and $(p^+ \sin\beta + g^+ \cos\beta)_L$. The rotation of the quarks leads to an explanation for the mysterious $\Delta I = 1/2$ rule observed in nonleptonic decays. By allowing for a direct coupling between N^0_R and μ^-_R the effective strength of neutral currents could be sufficiently larger in some processes without disagreement with experiments on $\nu + N \to \nu + X$ or precision experiments involving quantum-electrodynamic phenomena. Besides neutral-current effects that could be of experimental interest, the decay of the g^+ quark entails no enhancement of K/π branching ratio and its interaction with charged W, say in the reaction $\nu_\mu + N^0 \to g^+ + \mu^-$, is enhanced relative to $\nu_\mu + N^0 \to p^+ + \mu^-$ to $G_F \cot\beta$. The fermion mass matrix has interesting properties and the electron and the muon mass vanish "naturally" in zeroth order and should therefore be computable theoretically. (auth)

31384 THE PSION FAMILY: RELATIVISTIC CHARMONIUM. Chang, N. (Physics Department, City College of the City University of New York, New York, New York 10031); Nelson, C.A. Phys. Rev. D 13: No. 5, 1345-1354 (1 Mar 1976).

The authors have reported earlier that the spectrum of the psion family suggests a treatment based on an O(4) harmonic-oscillator family with O(4) quantum number $M = 0$ (equally spaced, mass-squared linear Regge trajectories). This results in the new J^{PC} quantum numbers: 0^{++} for 2.8 GeV/c^2; 2^{++}, 1^{-+}, 0^{++} for the 3.4-GeV/c^2 mass region. All radiative decays are related through a single O(4) coupling $S_{\mu\nu}F_{\mu\nu}$, where $S_{\mu\nu}$ is the internal-space angular-momentum operator. In this article the details of the calculations of radiative transition widths and of the $\gamma\gamma$ angular correlation functions are given. Experimental signatures are discussed and compared with the nonrelativistic charmonium scheme; among others $J \to O$ (2.8) $+ \gamma$ and $\psi' \to O$ (2.8) $+ \gamma$ are small, being forbidden in the strict O(4) limit. O (2.8) is expected to be narrow like all other psions below the 4.0-GeV/c^2 region. $\chi_0(3.41)$ and $\chi_1(3.49)$ total widths are expected to be around 630 keV and 185 keV, respectively. The missing decays of ψ' could be due to $\psi' \to O + \omega$ ($\sim 32\%$). (auth)

31385 SPECTRA OF NEW HADRONS. Jaffe, R.L.; Kiskis, J. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 13: No. 5, 1355-1362 (1 Mar 1976).

The cavity approximation to the bag model is used to calculate the masses of the new hadrons in models which explain the ψ resonances in terms of new quark flavors. The charmed-quark scheme and Harari's six-quark scheme are considered in detail. Difficulties associated with gluon interactions and with the interpretation of the ψ' are also discussed. (auth)

31386 PROPAGATION OF "HEAT" IN HADRONIC MATTER. Weiner, R.M. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). Phys. Rev. D 13: No. 5, 1363-1375 (1 Mar 1976).

We investigate the space-time evolution of a local excitation hadronic matter (h.m.) in connection with the establishment of local thermodynamical equilibrium as assumed in statistical and hydrodynamical models. After a critical discussion of the concept of instantaneous equilibrium, we point out that peripheral reactions are a particularly useful source of information for the study of the fate of an excitation in h.m. We consider a local excitation ("hot spot") corresponding to a pre-equilibrium phase and which is created in peripheral inelastic reactions with $m_\pi \ll q \ll p_i$ where p_i is the incoming momentum of the projectile and q the momentum transfer. By solving the diffusion equation we obtain the distribution of the temperature field in the excited target (projectile) and compute all the relevant physical quantities such as average momenta of secondaries, multiplicities, and mass and energy distributions in semi-inclusive peripheral reactions. It turns out that these quantities have a very pronounced angular dependence leading to a strong asymmetry in these observables. The measurement of this asymmetry can provide information on the constants of h.m. We also discuss how large-$p_\perp$ events observed in the CERN ISR energy range might be due to pre-equilibrium emission in close analogy to pre-equilibrium nuclear decay. (auth)

31387 DIRECT LEPTON PRODUCTION AND THE DRELL-YAN MECHANISM. Bjorken, J.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Weisberg, H. Phys. Rev. D 13: No. 5, 1405-1408 (1 Mar 1976).

We suggest that the Drell-Yan mechanism, when applied to low-mass dilepton production, underestimates the yield by a factor ~ 25 because it neglects the contribution coming from annihilation of produced parton-antiparton pairs. If this is correct, the observed direct lepton production may be accounted for by electromagnetic production of low-mass dileptons possessing high total transverse momentum. (auth)

31388 DYNAMICAL REALIZATION OF BREAKING OF EXCHANGE DEGENERACY AND VIOLATION OF THE OKUBO-ZWEIG-IIZUKA RULE. Pinsky, S.S. (Department of Physics, The Ohio State University, Columbus, Ohio 43220); Snider, D.R. Phys. Rev. D 13: No. 5, 1470-1473 (1 Mar 1976).

A multiperipheral model that implements part of the Veneziano topological expansion and in which the cylinder correction breaks exchange degeneracy and produces violation of the Okubo-Zweig-Iizuka (OZI) rule as well as a Pomeron above one is presented. In the negative charge conjugation channel the model is identical to the O meson model of Freund and Nambu if continued to a spin-one pole on the daughter of the Pomeron. (auth)

31389 COMMENTS ON QUARK-CONFINEMENT POTENTIALS. Bose, S.K.; Jabs, A.; Müller-Kirsten, H.J.W. (Department of Physics, University of Kaiserslautern, Kaiserslautern, Germany). Phys. Rev. D 13: No. 5, 1489-1493 (1 Mar 1976).

Explicit expansions are derived for the wave functions eigenenergies, and Regge trajectories of the nonrelativistic wave equation for quark-confining potentials. (auth)

31390 SUGGESTION FOR TESTING THE HYPOTHESIS OF LOCAL COMPENSATION OF TRANSVERSE MOMENTUM. Weingarten, D. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 13: No. 5, 1494-1495 (1 Mar 1976).

We describe an experimental test of the hypothesis of local compensation of transverse momentum in multiparticle production. This experiment does not require the detection of neutral particles. (auth)

31391 CALCULATIONS OF BARYON PARAMETERS IN THE EXTENDED MODELS OF HADRONS. Cocho, G. (International Centre for Theoretical Physics, Trieste, Italy); Fortes, M.; Vucetich, H. Phys. Rev. D 13: No. 5, 1513-1517 (1 Mar 1976).

Within the frame of the extended models of hardons ("bag" theories), in the semiclassical (spherical cavity) approximation, we discuss the computation of baryon parameters taking into account the interaction among quarks. We consider, as trial wave functions, arbitrary sums of antisymmetrized products of one-quark wave functions obeying the Dirac equation for an arbitrary central potential. It is shown that if the electromagnetic interaction is the minimal one $\bar{\psi}\gamma_\mu\psi$, then $\rho \equiv 9\mu_p{}^2/\langle r_p{}^2\rangle \leqslant 1$, where μ_p and $\langle r_p\rangle^{1/2}$ are the magnetic moment and root mean square radius of the proton (to be compared with the experimental value $\rho \simeq 1.06$). It is also shown that if $\rho = 1$, then the axial nucleon charge $g_A/g_V = 5/9$. (auth)

31392 ANALYTIC CONTRIBUTIONS TO THE g FACTOR OF THE ELECTRON. Levine, M.J.; Perisho, R.C. (Department of Physics, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213); Roskies, R. Phys. Rev. D 13: No. 4, 997-1002 (15 Feb 1976).

We compute the analytic value of seven more graphs contributing to the g factor of the electron in sixth order. After comparing with other numerical and analytic evaluations, we give an updated "best" theoretical estimate of the g factor, and compare it to the experimental value. (auth)

31393 DUAL CURRENTS IN ARBITRARY SPACE-TIME DIMENSION. Johnson, E. A. (The City College of The City University of New York, New York, New York 10031). Phys. Rev., D; 13: No. 4, 1021-1024(15 Feb 1976).

Schwartz has shown a procedure for describing off-mass-shell states in dual models. The construction of such states is an important preliminary to constructing physical currents. The basis requirement motivating the construction of such states is that amplitudes with off-mass-shell lines should contain exactly the same spectrum of hadrons as the corresponding on mass-shell model. This condition, which one must necessarily impose if one hopes to describe physical currents, led Schwarz to construct a dual current for a particular choice of space-time dimension D, namely D = 16. Since this is not the critical dimension of the Veneziano model, a modification of the model appears to be necessary in order to bring the two dimensions into coincidence. In this paper a method is constructed to find solutions which hold for any choice of space-dimension D. This current is constructed perturbatively, and a unique solution is found up to the 6th level, given a few assumptions. (AIP)

31394 RADIATIVELY INDUCED SPONTANEOUS SYMMETRY BREAKING FOR ASYMPTOTICALLY FREE GAUGE THEORIES. Gildener, E. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 13: No. 4, 1025-1042 (15 Feb 1976).

We investigate the possibility that the symmetry of asymptotically free theories whose effective scalar quartic coupling constants (in the sense of the renormalization group) take on negative values is dynamically spontaneously broken. We find this phenomenon to be common for theories whose scalars transform as the irreducible second-rank tensor representations of SU(n) and O(n). The symmetry-breaking pattern is determined by the tree approximation in some cases, by the one-loop approximation in other cases, but for none of these models does it allow for an asymptotically free theory whose S-matrix elements are defined. Our dynamical mechanism does provide a natural explanation of superstrong spontaneous symmetry breaking. (auth)

31395 HAVE MESONS COMPOSED OF CHARMED DIQUARKS BEEN DISCOVERED? Rosenzweig, C. (Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. Lett. 36: No. 13, 697-700 (29 Mar 1976).

I suggest that the structure observed between $\sqrt{s}$=3.9 and 4.5 GeV at SPEAR is due to the presence of exotic mesons composed of a charmed diquark and antidiquark. Arguments for the existence of such mesons are reviewed. The characteristic features, i.e., masses, narrow widths, and abundance, which enable them to explain the data are presented. Further properties and yet another narrow meson with $m \simeq 6.7$ GeV/c^2 is predicted. (auth)

31396 INVARIANCES OF APPROXIMATELY RELATIVISTIC HAMILTONIANS AND THE CENTER-OF-MASS THEOREM. Stachel, J. (Department of Physics, Boston University, Boston, Massachusetts 02215); Havas, P. Phys. Rev. D 13: No. 6, 1598-1613 (15 Mar 1976).

In an earlier paper we considered a class of Lagrangians for directly interacting particles, arising from a slow-motion approximation in various special- and general-relativistic field theories. It was shown that if the Lagrangian is invariant under time and space translations this implies invariance under an additional three-parameter set of infinitesimal transformations, which leads directly to the center-of-mass theorem. This result is rederived here in a Hamiltonian formalism, in which these infinitesimal transformations are shown to be generators of a Lie symmetry group in phase space. Then we consider the problem of the most general form possible of a canonical post-Newtonian theory, that is a realization of the Lie algebra of the Poincaré group to order c^{-2} and that arises from a theory of the usual Newtonian type with two-body interactions. It is found that in such a theory the world-line condition is satisfied to order c^{-2}. This canonical theory encompasses all the approximately relativistic interactions, found recently by Woodcock

and Havas, which follow from a Fokker-type special-relativistic variational principle for particles with direct two-body interactions. The relation of our work to various other approaches to approximately relativistic theories of interacting particles is discussed. (auth)

Electromagnetic

Refer also to abstracts 31235, 31241, 32016, 32031, 32133, 32137, and 32145.

31397 ANGULAR DISTRIBUTION AND CROSS-SECTION MEASUREMENT OF THE ELEMENTARY PROCESS OF ELECTRON-ELECTRON BREMSSTRAHLUNG. Nakel, W.; Pankau, E. (Tuebingen Univ. (F. R. Germany). Physikalisches Inst.). Z. Phys., A; 274: No. 4, 319-325(Oct 1975). (In German)

By using an electron-photon coincidence technique, the absolute cross section has been measured of electron-electron bremsstrahlung in dependence of the photon emission angle for a definite energy and a definite angle of the outgoing electron. An electron beam of 300 keV was used, incident on a carbon target. Within the experimental errors agreement with theoretical calculations is found. Simultaneously with the electron-electron bremsstrahlung the elementary process of electron-nucleus bremsstrahlung of carbon was measured. (DE)

31398 EQUIVALENCE OF CAUSAL AND NONCAUSAL DESCRIPTIONS OF PHOTON EMISSIONS. Soln, J. (Harry Diamond Labs., Adelphi, MD). Lett. Nuovo Cim.; 15: No. 7, 245-248 (14 Feb 1976).

Using a given interaction Lagrangian density for the interaction of a photon field with a classical (nonquantized) charged current, a study is made of the extent to which the usual causality principles can be violated by the physically equivalent S matrices. (JFP)

31399 SOLUTIONS OF THE KLEIN–GORDON AND DIRAC EQUATIONS FOR PARTICLE WITH A PLANE ELECTROMAGNETIC WAVE AND A PARALLEL CONSTANT ELECTRIC FIELD. Narozhnyi, N. B.; Nikishov, A. I. (Lebedev Inst. of Physics, Moscow). Teor. Mat. Fiz.; 26: No. 1, 16-34(Jan 1976). (In Russian).

Complete orthogonal sets of solutions of the Klein–Gordon and Dirac equations are obtained for a particle moving in a plane electromagnetic wave plus a constant (in space and time) electric field parallel to the direction of propagation of the wave. The solutions are labeled by the numbers p_1, p_2, p_3 which form the conserved 3-momentum vector when the plane wave field is switched off. The solutions are connected through the integral transformation with the (found earlier) solutions labeled by the conserved quantum numbers p_1, p_2, $p_- = p_0 - p_3$. The ψ_{p_1, p_2, p_3} solutions as distinct from ψ_{p_1, p_2, p_-} are finite everywhere and are explicitly classified according to the sign of the frequency for $x_0 \to \pm\infty$. It turns out that such classification can also be made for ψ_{p_1, p_2, p_-}. This circumstance makes it possible to use the ψ_{p_1, p_2, p_-} solutions for writing down matrix elements in a usual way. The propagators in the Fock – Schwinger and Feynman representations are obtained. It is shown that differential probabilities for pair production by the external field considered are independent of the plane wave field, if they are expressed in terms of the Lorentz- and gauge-invariant quantities. (auth)

31400 THEORY OF BREMSSTRAHLUNG OF FAST ELECTRONS. Akhiezer, A. I.; Boldyshev, V. F.; Shulga, N. F. (Physical-Technical Inst., Kharkov). Yad. Fiz.; 22: No. 6, 1185-1195 (Dec 1975). (In Russian).

An effective bremsstrahlung cross section of fast electrons is calculated for a general field by using quasiclassical wave functions of an electron in an external field and the expansion in the momentum reciprocal degrees. The accuracy can be checked at any calculation step. It is shown that the bremsstrahlung cross section can be written as a product of the elastic cross section and of the bremsstrahlung probability, the accuracy of such factorization being a function of the frequency and the kind of external field. For the Coulomb field a correction is found proportional to the momentum reciprocal. The bremsstrahlung arising when the electron moves through a chain of atoms is used as an example to show that the above correction is proportional to the square of the number of atoms of the chain. (auth)

31401 $\gamma p \to \pi\Delta$ PROCESSES AND ELECTROMAGNETIC SUM RULES. Zayatz, A. A. (Physical-Technical Inst., Kharkov). Yad. Fiz.; 22: No. 6, 1196-1199(Dec 1975). (In Russian).

The contribution from $\gamma p \to \pi\Delta$ processes to electromagnetic sum rules is calculated in the framework of gradient-invariant model. (auth)

31402 RADIATIVE CORRECTIONS TO INVERTED ELECTROPRODUCTION ON PIONS. Shumeyko, N. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 6, 1200-1201 (Dec 1975). (In Russian).

Radiative corrections to the process $\pi^- p \to n e^+ e^-$ are calculated in the soft photon approximation. (auth)

31403 CALCULATION AND COMPARISON WITH EXPERIMENTAL DATA OF THE CASCADE CURVE FOR LIQUID XENON. Strugal'skii, Z. S.; Yablonskii, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 6, 1265-1266(Dec 1975). (In Russian).

An evaluation was made of the approximations and simplifications used in the calculation of the shower cascade curves by the moment method. Calculations were made for γ energies from 40 to 2000 MeV at a cutoff energy for the shower electrons of 3.1 ± 1.2 MeV in the experiments and 3.5 MeV in the calculations. A summary of the results obtained of the dependence of the mean number of shower electrons on the depth for the development of the shower is given for experimental studies and calculated data. (JSR)

31404 RADIATIVE ASYMMETRY IN $e^+e^- \to \mu^+\mu^-$ NEAR A NARROW RESONANCE WITH POLARIZED BEAMS. Greco, M.; Grillo, A. F. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 15: No. 6, 174-178(7 Feb 1976).

The results of the evaluation of forward–backward asymmetry in $e^+e^- \to \mu^+\mu^-$ interactions near a narrow vector resonance are presented in the case of polarized beams. The evaluation shows that the inclusion of the possible radiative polarization of the electrons and positrons in the storage ring reduces even more the charge asymmetry in the angular distribution. (JFP)

31405 HADRONS IN EXTENSIVE AIR SHOWERS. I. Theoretical Analysis. Kempa, J. (Durham Univ., Eng.). Nuovo Cim., 31A: No. 4, 568-580(21 Feb 1976).

Calculations were made of some features of extensive air showers (EAS) expected in the near vertical direction at different altitudes in the atmosphere for two models of the nucleon-air-nucleus interaction. Results are given for the electron and hadron components. It is shown that the lateral density distribution of hadrons in EAS is well described by the function $\rho_H(r)dr = (N_H(>E)/8!\pi r_0^2)\exp[-\sqrt[4]{r/r_0}]dr$, where r_0 is a parameter weakly dependent on the multiplicity law of secondary-particle production. The most useful energy for measurement of the total number of hadrons in showers with different numbers of particles is derived from the calculations. (auth)

31406 HADRONS IN EXTENSIVE AIR SHOWERS. II. Comparison Between Theoretical Predictions and Experimental Results. Kempa, J. (Durham Univ., Eng.). Nuovo Cim., 31A: No. 4, 581-592(21 Feb 1976).

A continuation is given of the theoretical analysis given previously. A detailed comparison between prediction and experiment was made for the energy spectrum and the lateral density distribution of hadrons in showers in the region of (10^4 to 10^6) particles for different altitudes in the atmosphere. Both models analyzed previously predict the measured shape of the energy spectrum of hadrons in EAS up to 10^4 GeV. From a comparison between the theoretical predictions of the lateral distributions of hadrons and the experimental results an increase of the mean value of transverse momentum with energy is expected. The mean value of the inelasticity coefficient for energies up to above 10^6 is estimated. Confirmation has been made of the "optimum" energy idea given by Kempa. (auth)

31407 POSITIVITY AND AN ANALYSIS OF ASYMPTOTIC AND NONASYMPTOTIC EFFECTS IN ELECTRON–POSITRON ANNIHILATION PROCESSES. Choudhury, D. K. (Daresbury Lab., Warrington, Eng.). Nuovo Cim., 31A: No. 4, 669-695 (21 Feb 1976).

A detailed positivity analysis of $e^+e^- \to$ hadrons and $e^+e^- \to \bar{p} + x$ is made within a framework of light-cone expansion/parton theory. A positivity bound for the asymptotic ratio $R_\infty = \lim \sigma(e^+e^- \to \text{hadrons})/s \to \infty\ \sigma(e^+e^- \to \mu^+\mu^-)$ is derived and the stability of such a bound is studied by including nonleading terms up to third order. Corresponding positivity domains for the nonasymptotic ratios $R(s) = \sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-)$ (s finite), inclusive distribution $s(d\sigma/dx)(e^+e^- \to \bar{p} + x)$ and inclusive angular distribution $s(d\sigma/dx d\cos\theta)(e^+e^- \to \bar{p} + x)$ are also estimated in the present accelerator energies and predictions are made for future energies. The extra assumption is the validity of the Gribov-Lipatov reciprocity relation for $e^+e^- \to \bar{p} + x$ in the asymptotic region. The analysis suggests that scaling of $\sigma(e^+e^- \to \text{hadrons})$ will set in within the SPEAR II limit (~81 $(\text{GeV})^2$), while that of $\sigma(e^+e^- \to \bar{p} + x)$ will set in beyond this limit for slow particles in the center-of-mass frame (i.e. for the pionization region). (auth)

31408 UNIFIED, RELATIVISTIC QUARK MODEL FOR MESONS. Tryon, E.P. (Department of Physics and Astronomy, Hunter

College of The City University of New York, New York, New York 10021). Phys. Rev. Lett. 36: No. 9, 455-458 (1 Mar 1976).

A relativistic wave equation is solved for equal-mass quarks interacting via a combined linear and "Coulombic" potential, the latter being softened at short distances in accord with asymptotic freedom. Assuming that colored SU(4) is broken only by the quark mass differences, I predict masses and leptonic decay widths for the ρ, ϕ, and ψ meson families of states. Agreement with experiment is excellent. (auth)

31409 INTERPRETATION OF ρ^0-ω^0 COHERENCE IN $\bar{p}p$ ANNIHILATION. Fields, T. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 36: No. 9, 489-490 (1 Mar 1976).

It is noted that the quark-rearrangement model provides a simple explanation of both the coherence and phase of the ρ^- and ω^0 amplitudes as observed in the $\rho^0\pi^+\pi^-$ and $\omega^0\pi^+\pi^-$ final states of low-energy $\bar{p}p$ annihilation. (auth)

31410 SOURCE THEORY ANALYSIS OF ELECTRON–POSITRON ANNIHILATION EXPERIMENTS. Schwinger, J. (Univ. of California, Los Angeles). Proc. Natl. Acad. Sci. U.S.A.; 72: No. 12, 4725-4728(Dec 1975).

The phenomenological viewpoint already applied to deep inelastic scattering is extended to the discussion of electron-positron annihilation experiments. Some heuristic arguments lead to simple forms for the pion differential cross section that are in reasonable accord with the published experimental data in the energy interval 3 to 4.8 GeV. (auth)

31411 COMPARISON OF THEORY AND EXPERIMENT IN PHOTOPRODUCTION. Donnachie, A. (Univ. of Manchester, Eng.). pp 473-510 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The comparison of theory and experiment for baryon resonances includes quark models and the Melosh transformation, partial wave analysis, and transition form factors of the nucleon resonances. Also covered are the high energy processes of pseudoscalar meson photoproduction and electroproduction and vector meson dominance. (JFP)

31412 THEORY OF INELASTIC LEPTON INTERACTIONS. Llewellyn Smith, C. H. (Oxford Univ.). pp 709-736 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The treatment of inelastic lepton interactions includes the scaling phenomenon, evidence for quark quantum numbers, and new quarks and new currents. (JFP)

31413 INCLUSIVE AND EXCLUSIVE VIRTUAL PHOTOPRODUCTION RESULTS FROM CORNELL. Hanson, K. M. (Cornell Univ., Ithaca, NY). pp 739-780 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The results for a series of photoproduction experiments are described. The reaction gamma + p is considered as an exclusive and as an inclusive reaction. Results are given for differential cross sections, structure functions, and particle number ratios. (JFP)

31414 NEW CERN MUON (g-2) EXPERIMENT AND OTHER RECENT DEVELOPMENTS IN QUANTUM ELECTRODYNAMICS. Combley, F. H. (Univ. of Sheffield, Eng.). pp 913-938 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

Details of the new measurement of the anomalous magnetic moment of the muon, carried out at CERN, are presented and followed by a survey of other recent high precision tests of quantum electrodynamics. It is shown that the further refinement of experimental technique and theoretical calculation has left QED intact and in particular that the weight of evidence stands firmly against there being any sizeable modification of the Adler type, to the effect of vacuum polarization. (auth)

31415 ANALYSIS OF A REPORTED MAGNETIC MONOPOLE. Alvarez, L. W. (Univ. of California, Berkeley). pp 967-979 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

It is shown that there are several substantive errors in a recent work describing a cosmic ray event consistent with the hypothesis that it was caused by a magnetic monopole. The previous interpretation admitted of only two alternatives: that the particle was a nucleus with Z greater than or equal to 125, beta equals greater than or equal to 0.92 or that the particle was a monopole with g equals 137e and any velocity sufficient to penetrate the 1.6 gm/cm^2 stack. It is shown that the rejection of the first alternative is no longer valid. (JFP)

31416 INVESTIGATION OF THE TRANSITION EFFECT IN LAYERED ABSORBERS. Vit'ko, V. I.; Grishaev, I. A.; Kovalenko, G. D. At. Energ. (USSR); 39: No. 4, 275-277(Oct 1975). (In Russian).

The development of showers initiated by 1-GeV electrons in a layered medium was investigated. The medium in which the development of the cascade took place was copper the distorting layer–carbon. It has been shown that the presence of a distorting layer having a higher critical energy than that of the main absorbed reduces considerably the number of charged particles in the shower. The transition effect measured after a thickness of 0.5 radiation length of the main absorber agrees closely with values of theoretical calculations. For other thicknesses, the transition effect is less than the theoretically predicted value. The obtained results can be used to calculate the shielding required for high energy particle accelerators. (3 figs. 10 refs.)

31417 MACH'S PRINCIPLE, GRAVITATION AND ELECTROMAGNETISM: THE ELECTROMAGNETIC INERTIA OF CHARGED ELEMENTARY PARTICLES. Woodward, J. F. (California State Univ., Fullerton (USA)); Yourgrau, W. (Department of Supply, Melbourne (Australia)). Astron. Nachr.; 296: No. 3, 111-118(1975).

The question of the magnitude and behavior of the electromagnetic contribution of the mass of an elementary charged particle is explored. It is shown that, if the "cut-off" of the relativistic quantum electrodynamics is taken as an approximation to the physical process embodied in the postulates: (1) that the bare charge of an elementary particle may only emit and absorb virtual photons having energies that are integral multiples of some fundamental energy, and that (2) the observed charge of an elementary particle is a constant independent of its "radius," the electromagnetic mass of such a particle is always finite, even when the radius of the particle becomes zero. Alternative postulates that will resolve the cut-off dilemma are briefly discussed. (GC)

31418 CONSIDERATION OF THE RESONANCE STRUCTURE OF THE CROSS-SECTIONS IN MONTE-CARLO CALCULATIONS. Seifert, E. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Kernenergie; 18: No. 7, 214-216(1975). (In German)

If marginal effects are of importance in calculating neutron distributions, many of the commonly used approximations cannot be applied. In particular, the locally varying resonance blocking of the cross sections in the epithermal and fast energy ranges has to be taken into account correctly. The Monte Carlo method in combination with subgroup data is well suited for this.

31419 GENERATION OF NATURAL FREQUENCY OF BOUND ELECTRONS IN SCATTERING OF PULSES OF RADIATION. Prakash, H.; Ajai (Allahabad Univ. (India). Dept. of Physics). Proc. Indian Natl. Sci. Acad., Part A; 40: No. 2, 124-132(Mar 1974).

It is shown quantum mechanically that if a pulse of radiation is scattered by harmonically bound electrons, the natural frequency of bound electrons is also generated in scattering. The cross section for this phenomenon is found to be $\sigma(\Omega) = \sigma_T(n/2\mu)(\Omega T_C)^{-2}\{[\Omega/(\Omega+\omega)]^2 + [\Omega/(\Omega-\omega)]^2\}$ where Ω is the natural frequency of the bound electrons, σ_T is Thomson scattering cross-section, n is the pulse repetition frequency, $(2\mu)^{-1}$ is the relaxation time for damping due to the spontaneous emission, T_C is the time taken by the pulse in growth and decay, and ω is the mean frequency of the incident radiation. The results agree with the corresponding classical results obtained by other workers in the field. (auth)

31420 MULTIPLE SCATTERING IN THE COMPTON EFFECT. Pt. 1—The Total Intensity of Double Scattering. Williams, B. G. (Strathclyde Univ., Glasgow (UK). Dept. of Applied Physics); Halonen, V. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Phys. Fenn.; 10: No. 1, 5-20(Mar 1975).

The ratio of double to single scattering in the Compton effect has been investigated both qualitatively and also using a Monte Carlo method for numerical integration. Only the total intensity has been considered. The effect of incident energy, absorption and sample geometry has been studied. The effective sample thickness is found to be a useful parameter for determining the amount of double scattering. (auth)

31421 ROLE OF TWO-PHOTON CHANNEL IN THE INCLUSIVE CROSS SECTION OF THE REACTION $pp \rightarrow e(\mu)^+ \ldots$ AT LARGE TRANSVERSE MOMENTA. Kotkin, G. L.; Serbo, V. G. (State Univ., Novosibirsk, USSR). Yad. Fiz.; 23: No. 1, 139-141(Jan 1976). (In Russian)

It is shown that the dependence $\epsilon d\sigma(pp \rightarrow \mu + \ldots)/d^3p = \varphi(x_\perp)/p_\perp^8$ obtained in experiment must be more smooth in region of larger $p_\perp$ (at fixed $x_\perp$), because the obtained lower estimate for this cross section, that is determined by the two-photon channel, is $\geq g(x_\perp)/p_\perp^8$, where $g(x_\perp) \sim (\alpha^2/\pi)^2\varphi(x_\perp)$. (auth)

31422 CHECK OF SUM RULES FOR PHOTON INTERACTION CROSS SECTIONS IN QUANTUM ELECTRODYNAMICS AND MESODYNAMICS. Gerasimov, S. B.; Moulin, Zh. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 23: No. 1, 142-153(Jan 1976). (In Russian)

The sum rules for photon interaction cross sections derived by using the perturbation theory in the quantum field theory models are verified. Possible modifications of several sum rules are considered. Arguments are given in support of validity of Cabibbo–Radicati sum rule in all orders of strong interaction coupling constants in the "chiral" limit of infinitely small pion mass. (auth)

31423 PHOTOPRODUCTION OF NEUTRAL AND CHARGED VECTOR MESONS. Arekelyan, G. G.; Eremyan, Sh. S. (Erevan Physical Inst.). Yad. Fiz.; 23: No. 1, 154-162(Jan 1976). (In Russian)

A method of calculation is presented that enables one to describe universally all the processes of binary photoproduction and relating them to photoproduction of neutral vector mesons. With this is view the neutral vector-meson photoproduction is considered in connection with elastic πN and KN scattering, described previously in framework of the modified "quasi-eikonal" model. Taking into account relations obtained from the quark model and from the VDM, one needs no new parameters. The vector-meson photoproduction is considered as an example of the present method. Agreement with the experimental data is quite satisfactory. An estimate for the higher bound to the ψ (3100)-meson photoproduction is also given. (auth)

31424 e^+e^- ELECTROPRODUCTION SPECTRA IN THE FRAGMENTATION REGION. Kuraev, E. A.; Lipatov, L. N.; Merenkov, N. P.; Strikman, M. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yad. Fiz.; 23: No. 1, 163-173(Jan 1976). (In Russian)

Energy distributions of particles in the process $e^+e^- \rightarrow e^+e^-e^+e^-$ are found for the kinematical case when the produced pair moves in the direction of one of the initial particles and has the energy of the order of the energy of the initial particle. These distributions take into account the two-photon and one photon (bremstrahlung) mechanisms of pair production and their C-odd interference and identity of electrons in the final state. The cross section is estimated in the case when the positrons escape at the angles $\theta \gg 1/\gamma = m/E$ with respect to the beam axes in the c.m.s. (E is the c.m.s. energy of one of the initial particles.) The presented results show that the process under consideration can be studied experimentally. (auth)

31425 ANGULAR DISTRIBUTIONS IN RESONANCE REACTIONS ANTI aa $\rightarrow \psi^0(Z^0) \rightarrow$ ANTI bb. Bugaev, E. V.; Zheleznykh, I. M. (Inst. of Nuclear Research, Moscow). Yad. Fiz.; 23: No. 1, 174-179(Jan 1976). (In Russian)

General expressions are obtained for cross sections and angular distributions of particles in resonance reactions like $\bar{a}a \rightarrow \psi^0(Z^0) \rightarrow \bar{b}b$ where $\psi^0(Z^0)$ is neutral massive vector meson, a and b arbitrary particles. In particular, formulas are obtained for cross sections and angular distributions in reactions $e^+e^- \rightarrow \psi^0(Z^0) \rightarrow \bar{l}l$, $\pi^+\pi^-$, p^+p^-, as well as $\bar{p}p \rightarrow \psi^0(Z^0) \rightarrow \bar{l}l$, $\pi^+\pi^-$, $\bar{N}N$. The interference with electromagnetic processes is taken into account. (auth)

31426 INFLUENCE OF THE REACTION MECHANISM ON THE ASYMMETRY IN THE $\gamma d \rightarrow \pi^0 d$ REACTION. . Lazard, C. (Inst. of Nuclear Physics, Orsay, France); Maric, Z. Lett. Nuovo Cim.; 15: No. 8, 284-288(21 Feb 1976).

The study of the cross section asymmetry in coherent photoproduction of pions on deuterons using polarized photon beams, is of particular interest since it may serve as a tool for getting information on the isovectorial part of the photoproduction amplitude on a single nucleon. This statement is based on the small sensitivity of the asymmetry parameter. The asymmetry parameter is calculated in the approximation of the equipartition of the total transferred momentum between two elementary processes. The angular distribution of this parameter is shown. (JFP)

31427 DIFFRACTIVE DISSOCIATION IN A HADRONIC CLUSTER BREMSSTRAHLUNG MODEL. Bialas, A. (Jagellonian Univ., Krakow); Stern, J.; Zalewski, K. Acta Phys. Pol., Ser. B7: No. 3, 197-210(Mar 1976).

Using the uncorrelated cluster emission as a model for non-diffractive processes, the diffractive production is estimated. Multiplicity and leading particle distributions in diffraction dissociation are discussed. The cross section for diffractive production is calculated and appears consistent with the data. (auth)

31428 OSCILLATORY MOTION OF THE MAGNETIC MOMENT IN AN INHOMOGENEOUS MAGNETIC FIELD. Pszczola, J. (Dept. of Solid State Physics, Krakow). Acta Phys. Pol., Ser. A49: No. 2, 163-167(Feb 1976).

Simple examples of harmonic oscillations of the magnetic moment in an inhomogeneous magnetic field are described. Formulas for angular frequencies of oscillations are derived. The way of measuring the magnetization or magnetic susceptibility of magnetic substances results from the derived formulas. (auth)

31429 PHOTO- AND ELECTROPRODUCTION OF Λ AND EPSILON HYPERONS ON NUCLEONS NEAR THE THRESHOLD. Krive, I. V. (Kharkov State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 102-108(1975). (In Russian).

The cross sections for the photo- and electroproduction of strange particles on nucleons near the threshold were calculated in the framework of the current algebra model. It was shown that the existing experimental data does not contradict the model predictions. (tr-auth)

31430 RADIATION EFFECTS IN LEPTON DECAYS OF NEUTRAL VECTOR MESONS AND μ^-e UNIVERSALITY. Kerimov, B. K.; Tsvetkov, V. P. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 84-89(1975). (In Russian).

The effect of α order radiative correction to the probability of lepton decay of moving neutral vector mesons $V \rightarrow e^+e^-$ and $V \rightarrow \mu^+\mu^-$ ($V = \rho^0, \omega, \varphi$). With the purpose of verifying μ^-e universality, the problem of the effect of radiation correction (caused by the exchange of virtual photons between leptons and antileptons, by the polarization of the vacuum from the electron e^+e^- and muon $\mu^+\mu^-$ closed loops, and by the irradiation of soft photons) on the partial widths of the electron and muon modes of V meson decay was discussed. From the closed expressions obtained for the corrections it follows that the ratio $|R_V|$ of the probability of V meson decay into e^+e^- and $\mu^+\mu^-$ pairs with consideration of the radiation correction agrees well with available experimental data on the decays $\rho^0 \rightarrow e^+e^-$ and $\mu^+\mu^-$ and indicates the possible deviation from μ^-e universality in $\varphi \rightarrow e^+e^-$ and $\mu^+\mu^-$ decays. (tr-auth)

31431 COHERENT STATES OF RELATIVISTIC PARTICLES. Bagrov, V. G.; Bukhbinder, I. L.; Gitman, D. M. (Tomsk State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 134-135 (1975). (In Russian)

The method of constructing coherent states of nonrelativistic particles was developed and applied to finding the coherent states of an electron. This problem has not yet been solved for relativistic particles. A method of constructing coherent states for particles which are describably by a Klein-Gordon and Dirac equation is proposed. In solving this problem the transition to the formalism of a zero plane is shown to be essential. Solution of the Dirac equation is obtained without difficulty. It is shown that the states which are actually obtained are coherent, and thus it is possible to construct the coherent states of relativistic particles. (SJR)

31432 BOUNDARY EFFECT IN ELECTRON–PHOTON SHOWERS. Kol'chuzhkin, A. M.; Shoshin, E. B.; Ryzhov, V. V. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 147-149(1975). (In Russian)

The number of particles in an electron-photon shower undergoes a sharp change near the boundary between two media. The magnitude of this effect directly on the boundary is calculated. In order to estimate the effect of the boundary on the shower characteristics it is necessary to know the direct current of particles in a homogeneous infinite medium and the differential current albedo. Such data do not exist at present in the literature. An experimental study of boundary effects was carried out on the bremsstrahlung beam of a cyclotron in measurements with x ray film. It was found that at $E_{max} = 900$ MeV at the boundary of barriers made of lead with a thickness of 3.12 and 7.55 radia-

tion units, the electron flux was a factor of 1.96 and 1.98 less than in a infinite adsorber. For adsorbers made of copper with a thickness of 3.66 and 6.25 radiation units the flux is decreased by factors of 1.36 and 1.52 respectively. These data indicate that the magnitude of the boundary effect is significant, and should be taken into account in estimating the average energy of a shower adsorbed in a detector of finite dimensions, in determining the yield of positrons and electrons from a converter, and in a number of other cases. (SJR)

31433 MOVEMENT OF A NEUTRAL FERMI PARTICLE, POSSESSING ANOMALOUS MAGNETIC AND ELECTRICAL MOMENTA, IN AN ELECTRIC FIELD. Klimenko, Yu. I. (Moscow Wood-Technology Inst.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 149-151(1975). (In Russian)

The motion of the neutral Fermi particle in an electric field of the kind E = nE(z), n = 0,0,1 is described by a generalized, Dirac equation. The wave function is found to be an eigenfunction of operators. Differential, second-order equations are obtained for each of the functions f and g satisfying the system of equations. A look is taken at a number of the most interesting cases of electric fields, for which these equations have exact solutions. (SJR)

31434 PAIR DEGENERATION BY THE FIELD OF A MOVING CHARGE. Skobelev, V. V. (Moscow Wood-Technology Inst.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 101-105(1975). (In Russian)

A look is taken at the degeneration of fermion and boson pairs by the field of a charge moving along the periphery. A diagram is presented that describes the degeneration of a fermion pair of spin $\frac{1}{2}$ with momenta p_1 and p_2 by a charge Q moving in a trajectory determined by a stationary external field. Since the smallest mass of a boson (π-meson) is two orders greater than the mass of an electron, the probability of $\pi^+\pi^-$-pair degeneration is very small ($x \sim 1/m$) in comparison with the probability of electron-positron degeneration. This effect is observable at $x = (\omega/m)(E/m_Q)^2 \sim 1$. (tr-auth)

31435 TOTAL MULTIPLICITIES IN THE PHOTOPRODUCTION AND ELECTROPRODUCTION ON NUCLEI. Nikolaev, N.N. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). JETP Lett. 22: No. 8, 202-203 (20 Oct 1975).

It is shown that the total multiplicities have a specific abrupt dependence on the virtual-photon mass $\sqrt{Q^2}$ in interactions with nuclei, in spite of the fact that the total multiplicities are the same in photoproduction and electroproduction on nucleons ($Q^2=0$ and $Q^2\neq 0$). The magnitude of the predicted effects reaches 30-40%. (auth)

31436 PRESENT STATUS OF THE CABIBBO-RADICATI SUM RULE. Dominguez, C.A.; Moreno, H. (Departamento de Física, Centro de Investigación y de Estudios Avanzados del I.P.N. Apartado Postal 14-740 México 14, D.F.). Phys. Rev. D 13: No. 3, 616-619 (1 Feb 1976).

We have reevaluated the Cabibbo-Radicati sum rule using recent data and analyses of pion photoproduction in the resonance region. As an alternate method we have applied the extended vector-dominance model together with the quark model and the latest pion-nucleon total cross sections. Both procedures consistently indicate a breakdown of the sum rule; the disagreements are 14% and 12%, respectively. (auth)

31437 PHENOMENOLOGICAL ANALYSIS OF THE PROPERTIES OF NARROW RESONANCES AND POSSIBLE EVIDENCE FOR A NEW QUANTUM NUMBER. Pham, T.N.; Pire, B.; Truong, T.N. (Centre de Physique Théorique de l'École Polytechnique, 91120 Palaiseau, France). Phys. Rev. D 13: No. 3, 620-628 (1 Feb 1976).

A phenomenological analysis is carried out to show that the narrow resonances at 3095 and 3685 MeV probably carry a new quantum number which forbids them to decay into ordinary hadrons by strong and medium-strong interactions. It is also shown that the radiative decay modes of these particles are considerably suppressed relative to that of ordinary hadrons. Production in hadronic collisions and photoproduction of these particles are analyzed in this framework. It is suggested that no resonance carrying the same new quantum number can exist with a mass below 2.5 GeV and that the 4.1-GeV resonance can only decay into 3095-MeV and 3685-MeV particles with a width of less than 1 MeV. It is shown, moreover, that the assignment of the ordinary SU(3) quantum numbers of ω (783) to these states, besides the new quantum number, is favored by experiments. (auth)

31438 POSSIBLE INTERPRETATION OF THE ρ' (1600) AS A THRESHOLD ENHANCEMENT. Langacker, P.; Segrè, G. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. D 13: No. 3, 697-706 (1 Feb 1976).

The possibilty that the ρ' (1600) is not a true resonance is examined. In the model considered the reactions $\gamma p \to \rho\pi^+\pi^- p$ and $e^+e^- \to \rho\pi^+\pi^-$ proceed through the production of a virtual ρ meson. The threshold factors associated with the opening of the $\rho\pi\pi$ channel are shown to combine with the virtual-ρ propagators to produce peaks in the $\rho\pi^+\pi$ mass spectra, similar in mass and width to the experimental spectra. However, a comparison of the relative magnitudes of the two reactions, when combined with experimental limits on the reaction $\pi^+ p \to \Delta^{++}\rho\pi^+\pi^-$, rules out this mechanism. The roles of final-state interactions and of the virtual mass dependence of the $\gamma p \to \rho p$ production amplitude are considered. It is then assumed that the ρ' is a real resonance. The $\rho'\gamma$ coupling and the $\rho' p$ total cross section are extracted. We find $f_{\rho'}{}^2/4\pi = 21 \pm 10$ and $\sigma_{\rho' p} = 23 \pm 4$ mb, as compared with the ρ-meson values of 2.1 ± 0.5 and 22.2 ± 2.6 mb. The background due to a ρ tail in the production of the recently reported ρ' (1250) is briefly discussed. (auth)

31439 ENHANCEMENT OF ASYMMETRY IN LEPTON ANNIHILATION DUE TO RESONANCES. Patil, S.H.; Rindani, S.D. (Department of Physics, Indian Institute of Technology, Bombay 400076, India). Phys. Rev. D 13: No. 3, 730-739 (1 Feb 1976).

We show that the asymmetry in $e + \bar{e} \to 2\pi$, 3π due to interference between one-photon and two-photon terms is quite large near the f, A_1, and A_2 resonance positions, but goes through a zero. The analysis of this asymmetry can yield important information about the resonances and theories describing them. (auth)

31440 DIFFRACTIVE CHANNELS IN ABSORPTIVE EIKONAL MODELS. Camillo, P.; Fishbane, P.M. (Physics Department, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. D 13: No. 3, 740-744 (1 Feb 1976).

We have examined the effect of an arbitrary number of diffractive channels on absorptive eikonal elastic scattering amplitudes. Diffraction is assumed to be turned on by some coupling constant, well above threshold. We find that the absorption of the scatterer is decreased at all impact parameters, leading to a decrease in the elastic, nondiffractive inelastic, and total cross sections. Ratios of cross sections are also examined. Finally, we find that the peripheral nature of diffractive production directly affects the nature of elastic scattering amplitudes near the center of the scattering region. (auth)

31441 PARITY NONCONSERVATION IN HIGH-TRANSVERSE-MOMENTUM COLLISIONS. Fischbach, E.; Look, G.W. (Physics Department, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 13: No. 3, 752-756 (1 Feb 1976).

It is suggested that the suppression of strong-interaction cross sections at large transverse momenta could make possible the detection of parity-nonconserving weak effects in high-energy collisions. A parton-model calculation for $pp \to pX$ gives parity-nonconserving effects of the order of 10^{-3} which could be detectable by presently available techniques. (auth)

31442 CARTESIAN ANALYSIS OF ANGULAR DISTRIBUTIONS IN $e^+e^- \to \psi' \to \psi\gamma\gamma' \to \mu^+\mu^-\gamma\gamma'$. Brown, L.S.; Cahn, R.N. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. D 13: No. 5, 1195-1198 (1 Mar 1976).

Angular distributions for the cascade $\psi' \to \chi\gamma' \to \psi\gamma\gamma' \to \mu^+\mu^-\gamma\gamma'$ are for $S_\chi = 0$, 1, 2. In a nonrelativistic quark model the ratio of the partial rates Γ_{M2}/Γ_{E1} can be calculated and is independent of the shape of the central binding potential. This ratio is of the order of (photon energy/quark mass)^2 and is numerically -0.0025. This supports the use of the dipole approximation for the radiation. The use of Cartesian tensors simplifies the determination of the angular distributions significantly. (auth)

31443 SYMMETRIES, ANGULAR DISTRIBUTIONS IN $\psi' \to \gamma\chi \to \gamma\gamma\psi$, AND THE INTERPRETATION OF THE χ (3400–3550) LEVELS. Karl, G. (Department of Physics, University of Guelph, Guelph, Ontario, Canada); Meshkov, S.; Rosner, J.L. Phys. Rev. D 13: No. 5, 1203-1215 (1 Mar 1976).

Recently a family of particles (to be denoted χ) has been discovered between 3400 and $\sim$ 3550 MeV. A formalism is presented for analysis of the decays ψ' (3684) $\to \gamma\chi \to \gamma\gamma\psi$ or $\gamma 0^{-0^-}$. This formalism is sufficiently general to allow for transitions of several multipolarities. Previous treatments have been restricted to the assumption that the above transitions are purely $E1$ if $J^P(\chi) = 0^+$, 1^+, and 2^+. Here (with some model-dependent motivation) this restriction is removed. The predictions of specific heavy-quark models for the χ states are then discussed. On the basis of the single-quark-transition picture (the Melosh transformation), it is anticipated that the state χ (3410) will be identified as a $^3P_0$ $q\bar{q}$ level, and will be found to have $J^{PC} = 0^{++}$. It is also anticipated that the $^3P_2$ level should be fairly prominent. (auth)

31444 HADRONIC MODELS FOR THE PHOTOPRODUCTION OF ψ'S. Sivers, D.; Townsend, J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); West, G. Phys. Rev. D 13: No. 5, 1234-1248 (1 Mar 1976).

We examine the photoproduction of the ψ (3095) within the context of

the assumption that the ψ contains a pair of new fundamental constituents. Using an inequality based on unitarity, we derive a lower limit on the cross section $\sigma(\gamma p \to D\bar{D} + \text{anything}) \gtrsim 300$ nb where the D's are hadrons carrying the new constituent bound to ordinary quarks. This suggests that it should be possible to detect D's from their leptonic decays in γ beams. Comparing the unitarity relations for $\gamma p \to \psi p$ and ψp, we predict corrections to the vector-dominance hypothesis so that $\sigma_{tot}(\psi p)$ is about a factor of two larger than expected. We discuss briefly the precision necessary for experiments on nuclear targets to test this prediction. (auth)

31445 IMPACT PARAMETERS AND ABSORBED REGGE POLES IN INCLUSIVE REACTIONS. Pumplin, J. (Department of Physics, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. D 13: No. 5, 1249-1260 (1 Mar 1976).

We derive an impact-parameter representation for inclusive reactions in the fragmentation region. We use this representation to calculate s-channel unitarity (absorptive) effects, by generalizing the methods which have proved successful in two-body reactions. The resulting procedure is also derived directly, using the technique of eikonal field theory. A general formula is given for absorptive corrections to triple-Regge models. We apply the formula to the reaction $\gamma p \to \pi^+ X$, and predict a turnover in $Ed\sigma/d^3p_\perp{}^2 \lesssim 0.015$ GeV^2, in contradiction to previous calculations with or without absorption. Direct arguments against the previous calculations are also presented. (auth)

31446 COUNTING QUARKS IN e^+e^- ANNIHILATION. De Rújula, A.; Georgi, H. (The Physics Laboratories, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 13: No. 5, 1296-1301 (1 Mar 1976).

A comparison of asymptotically free-quark-model predictions and e^+e^- annihilation data can be made by using a dispersion relation to continue the data into the spacelike region. We make this comparison for several models, including when appropriate the effect of heavy-quark masses. We conclude that the "old" theory with no charm is excluded, the standard model with charm is acceptable if heavy leptons are produced, and six-quark models are viable if no heavy leptons are produced. (auth)

31447 SPECULATIONS REGARDING A SCALAR PARTNER OF THE HYPOTHETICAL O PARTICLE. Willemsen, J.F. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 13: No. 5, 1327-1338 (1 Mar 1976).

Decays of ψ are studied in a resonance-domination model. The Okubo-Zweig-Iizuka rule is realized dynamically by the propagation of quarkless mesons. Free parameters in the model are fixed by using available experimental data. Then a number of specific predictions are made, which test the dynamical scheme. In particular, suggestions for where to look for the quarkless mesons as resonant enhancements in spectra are discussed quantitatively. (auth)

31448 LEPTONIC DECAYS OF MESONS IN AN APPROXIMATION TO THE MIT BAG MODEL. Hays, P.; Ulehla, M.V.K. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 13: No. 5, 1339-1344 (1 Mar 1976).

The MIT bag model is used to compute certain electromagnetic and weak leptonic decay rates of the pseudoscalar and vector mesons. Because of the limitations inherent in the cavity approximation we find that generally the results are not in good agreement with experiment. (auth)

31449 REGGE CUTS IN $\gamma\gamma$ SCATTERING. Jackson, C.P. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England). Phys. Rev. D 13: No. 5, 1430-1436 (1 Mar 1976).

It is shown that the Pomeron-Pomeron cut in $\gamma\gamma$ scattering has natural C parity and conspires, in contrast to the Pomeron pole which is evasive, and has natural parity and C parity. The constraints this places upon the invariant amplitudes are analyzed. (auth)

31450 RENORMALIZABLE WEAK AND ELECTROMAGNETIC INTERACTIONS AND NEW-QUANTUM-NUMBER PHENOMENA. Machacek, M.; Tomozawa, Y. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 13: No. 5, 1462-1469 (1 Mar 1976).

Renormalization gauge-field models of weak and electromagnetic interactions which include the $V+A$ charmed current are constructed and their significance is discussed. It is shown, in particular, that except in Harari's six-quark model the introduction of heavy leptons is necessary for renormalizability in the one- or three-charmed-quark schemes. (auth)

31451 INTERPLAY OF CONFINEMENT AND DECAY IN THE SPECTRUM OF CHARMONIUM. Eichten, E.; Gottfried, K.; Kinoshita, T.; Lane, K.D.; Yan, T.-M. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). Phys. Rev. Lett. 36: No. 10, 500-504 (8 Mar 1976).

The spectrum of charmonium in the presence of a charmed-meson continuum is investigated. Radiative rates are in considerably better agreement with data than for the naive model, the largest discrepancy being a factor 2–3 for $\psi' \to \gamma + {}^3P_0$. The model accounts for the peak at $\sim$4.2 GeV in σ ($e\bar{e} \to$ had), and predicts a further peak at $\sim$3.75 GeV due to 1^3D_1. The latter would be the most favorable location for a charm search in $e\bar{e}$ collisions. (auth)

31452 EXOTIC MESONS AND e^+e^- ANNIHILATION. Bander, M.; Shaw, G.L.; Thomas, P. (Department of Physics, University of California, Irvine, California 92717); Meshkov, S. Phys. Rev. Lett. 36: No. 13, 695-697 (29 Mar 1976).

Recent experiments at SPEAR indicate an unexpectedly large number of 1^{--} states in the energy range 3.9–4.4 GeV. We show how the existence of exotic $c\bar{q}cq$ mesons can account for these states as well as the rise in R and the missing ψ (3.7) decays. The width of these states does not require that they lie above the, as yet unobserved, $D\bar{D}$ threshold. Predictions of the model are readily testable. (auth)

31453 HELICITY-FLIPPING NEUTRAL CURRENTS AND $\gamma\gamma \to \nu\bar{\nu}$. Fischbach, E.; Gruenwald, J.T.; Rosen, S.P.; Spivack, H. (Physics Department, Purdue University, West Lafayette, Indiana 47907); Halprin, A.; Kayser, B. Phys. Rev. D 13: No. 6, 1523-1526 (15 Mar 1976).

The process $\gamma\gamma \to (\pi^0 \text{ or } \eta) \to \nu\bar{\nu}$, which can be induced by helicity-flipping scalar and/or pseudoscalar neutral currents, may be of significance in various astrophysical processes. For temperatures of order 10^{11} °K, the conversion rate into neutrinos via this mechanism is enormous, thus suggesting that this process may be important in the understanding of the early universe and of supernovas. (auth)

31454 DOMINANCE OF GROUND-STATE TRANSITIONS IN SYNCHROTRON RADIATION. White, D. (Department of Physics, Illinois Institute of Technology, Chicago, Illinois 60616). Phys. Rev. D 13: No. 6, 1791-1798 (15 Mar 1976).

Exact relativistic wave functions of an electron moving in a transverse uniform magnetic field are employed to calculate to first order the transition rates to the first excited state. The calculations are performed numerically for a wide range of electron energies and magnetic field strengths. It is found that for magnetic field strengths of the order of the critical field, viz., 4.414×10^{13} G, transition rates to the ground state are larger than those to the first excited state, independent of the electron energy. Furthermore, the energy difference between the second excited state and the ground state, corresponding to the field strength for which the rates to the ground state and first excited state are equal, is about $2mc^2$. This result is quite consistent with the phase-transition character in ordinary magnetic bremsstrahlung at $\hbar\omega \simeq 2mc^2$. (auth)

31455 THREE-LEVEL QUANTIZED SYSTEM FOR AN ELECTRON IN A HOMOGENEOUS MAGNETIC FIELD. White, D. (Physics Department, Illinois Institute of Technology, Chicago, Illinois 60616). Phys. Rev. D 13: No. 6, 1799-1801 (15 Mar 1976).

The characteristics of synchrotron radiation for an electron in the second excited state are explored at the place where the transition rate to the ground state equals that to the first excited state, i.e., where ground-state dominance sets in. It is found that when parity of the rates occur, two characteristic lengths of the system match, and the energy associated with a radiative loss channel matches the pair production threshold. (auth)

31456 MIXING ANGLE θ AND MAGNETIC MONOPOLE IN WEINBERG'S UNIFIED GAUGE THEORY. Hsu, J.P. (Center for Particle Theory, The University of Texas at Austin, Austin, Texas 78712). Phys. Rev. Lett. 36: No. 12, 646-649 (22 Mar 1976).

Gauge symmetry admits a local unit isovector and leads to the magnetic monopoles in Weinberg's unified theory. I predict $\sin^2\theta = 1/2$ for the mixing angle θ on the basis of Dirac's condition for charge quantization. This interesting result should be tested experimentally. (auth)

Weak

Refer also to abstract 31887.

31457 HEAVY NEUTRAL LEPTON AND NEUTRINO EXPERIMENTS AT FERMILAB. Gershtein, S. S.; Lapin, V. V.; Folomeshkin, V. N. (Inst. of High Energy Physics, Serpukhov, USSR). Yad. Fiz.; 22: No. 6, 1202-1205(Dec 1975). (In Russian).

Possible explanation of the results of the neutrino experiments at FERMILAB due to production of heavy neutral lepton is discussed. Production of the lepton with mass near 6 GeV may explain part of the observed effects (enhanced value of the hadronic mass in the one-muon and two-muon events, occurrence of the muon pairs). (auth)

31458 UPPER LIMIT FOR THE MAGNITUDE OF THE POSSIBLE VIOLATION OF THE LEPTON CONSERVATION LAW, BASED ON THE RESULTS OF NEUTRINO EXPERIMENTS IN A REACTOR. Domogatskii, G. V. (Inst. of Nuclear Research, Moscow). Yad. Fiz.; 22: No. 6, 1267-1269(Dec 1975). (In Russian).

On the basis of recent reactor experiments with the neutrino and antineutrino the upper limit for the creation of ^{37}Ar from antineutrino reactions was re-evaluated on the basis of identical properties of ν_e and $\bar{\nu}_e$. Recent studies on a ^7Li detector for the detection of solar neutrinos were evaluated for resolution of the question of this identity. It was concluded that in experiments with Li–Be detectors in a reactor the limitation found for ^{37}Ar production can be calculated in the first and second order of magnitudes with the same antineutrino current used in the original experiments by R. Davis. (JSR)

31459 MODEL OF DIMUON PRODUCTION BY NEUTRINOS. Sehgal, L.M.; Zerwas, P.M. (III. Physikalisches Institut, Technische Hochschule, Aachen, West Germany). Phys. Rev. Lett. 36: No. 8, 399-402 (23 Feb 1976).

In an attempt to confirm the charm interpretation of dimuons, we have constructed an explicit quark-parton model for the production and decay of a new hadron in neutrino interactions. The model produces, among other results, a distribution for the muon energy ratio $E(\mu^+)/E(\mu^-)$, which is independent of the neutrino spectrum and in remarkable agreement with observations. The model encourages the hope that the study of dimuon characteristics could reveal the charge of the charmed quark and the chirality of the charmed current. (auth)

31460 SEARCH FOR MUONIC PAIRS IN THE NEUTRINO EXPERIMENT AT THE IHEP 70 GeV ACCELERATOR. Khovanskii, V. D. (Inst. for Theoretical and Experimental Physics, Moscow). pp 605-612 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

Preliminary experimental data obtained in the neutrino beam at the Serpukhov 70 GeV accelerator are reported. About 15,000 neutrino interactions were analyzed in the search for two-muon events. The upper limit on the muon pair production cross section in the neutrino energy range up to approximately 30 GeV is presented. (auth)

31461 THEORY OF NEUTRAL CURRENTS AND ANOMALOUS NEUTRINO INTERACTIONS. Wolfenstein, L. (Carnegie-Mellon Univ., Pittsburgh). pp 613-633 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

Recent and prospective experiments on weak neutral currents are analyzed in terms of a general phenomenological description. Present experiments are consistent with the Weinberg model but important experiments on the isospin structure of the hadron current and on parity violation in electron-hadron interactions are awaited. The role of charmed and strange quarks in weak currents is discussed with particular reference to observations of dimuon events in neutrino reactions. (auth)

31462 REVIEW OF GAUGE THEORIES. Lee, B. W. (National Accelerator Lab., Batavia, IL). pp 635-650 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The review covers an outline of two outstanding issues in the theory of nonleptonic weak interactions. A summary of analyses of higher order weak interactions based on gauge theory is given. An important aim of this discussion is to get an idea of the mass scale set by the fourth quark. This is followed by a discussion on model building V + A currents. The motivations for such enterprises are emphasized. (JFP)

31463 MUON PROTON SCATTERING. Mozley, R. F. (Stanford Univ., CA). pp 783-792 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

Final states are examined in a muon--proton scattering experiment performed using a streamer chamber. An interesting similarity between data on charged multiplicity and those for e^+e^- annihilation was found. Examination of the π^- structure function shows scaling at high z when normalized to the total cross sections. When normalized to the cross sections for negative-pion-containing events, the structure function very closely resembles those from e^+e^- interactions. From the vector meson production study no Q^2 dependence was found in the production of either the rho^0 or omega after an initial drop from photoproduction values. The ratio of rho to omega production appears to remain the same from photoproduction to the highest Q^2 studied. The examination of the ratio of longitudinal to transverse cross sections in rho^0 production adds evidence for a rise near Q^2 equals 1 and possibly a later drop. (JFP)

31464 MEASUREMENT OF LONGITUDINAL COMPONENT OF PROTON POLARIZATION IN THE REACTION $\gamma+p\to\pi^0+p$ ON LINEARLY-POLARIZED PHOTONS. Gorbenko, V.G.; Derebchinskii, A.I.; Zhebrovskii, Yu.V.; Zybalov, A.A.; Kolesnikov, L.Ya.; Konovalov, O.G.; Rubashkin, A.L.; Sorokin, P.V.; Tenishev, A.E.; Tonapetyan, S.G. (Physico-technical Institute, Ukrainian Academy of Sciences). JETP Lett. 22: No. 7, 186-187 (5 Oct 1975).

Preliminary results are reported of the measurement of proton polarization in the reaction $\gamma+p\to\pi^0+p$ on a linearly polarized beam of photons with a polarization vector inclined 45° (135°) to the reaction plane. The longitudinal component of the polarization vector (P_z) is obtained. The experimental results are compared with the Schwela dispersion analysis and with the Walker phenomenological analysis. (auth)

31465 GAUGE THEORY OF WEAK INTERACTIONS III: MORE ON LEPTONS. Primack, J. R. (Physics Department, University of California, Santa Cruz). pp 499-515 of Proceedings of the Canadian Institute of Particle Physics Summer School, McGill University, 1973. Henzi, R.; Margolis, B. (eds.). Montreal, Quebec; The Institute of Particle Physics (1973).

From Canadian Institute of Particle Physics summer school; Montreal, Quebec, Canada (27 Aug 1973). (McGill Univ., Montreal, Quebec (Canada)).

A discussion of gauge theories of weak interactions is given with muons being the prime focus. A look is taken of anomalous muon interactions, attempts to understand why the rest mass of the electron is α times the rest mass of the muon and then some lepton–hadron analogies are given. Over all is the theme, from Feynman, "Why is the muon?" (MGH)

31466 WEAK INTERACTIONS OF CHARMED PARTICLES. Maiani, L. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica; Istituto Nazionale di Fisica Nucleare, Rome (Italy)). pp 1.0-1.28 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

Expected features of weak production and weak decay of charmed particles are illustrated. (FR)

31467 POSSIBLE IDENTIFICATION OF THE OUTGOING LEPTON IN NEUTRAL CURRENT REACTIONS. Wolfenstein, L. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). pp 289-290 of High Energy Neutrino Physics, Paris, March 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

In events without secondary muons there is a possibility for the secondary lepton not to be the same particle as the primary neutrino. So second class currents may exist that are distinguished by differences between neutrino and antineutrino reactions. (FR)

31468 STRONG W PAIR MODEL AND THE J PARTICLES. Marshak, R. E.; Mohapatra, R. N. (City Coll., New York (USA). Dept. of Physics). pp 405-437 of High Energy Neutrino Physics, Paris, March, 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

An identification with the two neutral members of a U(3) triplet of $_2$ bosons, whose charged member is responsible for weak interactions, is proposed for the two recently discovered resonances, J (3105) and J (3695). The integer charge of this W triplet oblige them to have a triality different from zero, $t = 1$. It can be deduced that the charged W boson responsible for weak interactions, must have approximately 4 GeV mass. The products of J' (3695) decay are also predicted to be J (3105) and K^0 or 2π, according to the identity or non-identity of the SU(3) groups for

bosons and hadrons. The decay is of the strong type, but due to the limited phase space and K^0 decay into a P wave, the real decay width of J′ (3695) is approximately 100 keV. J → electron anti-electron and J′ → electron anti-electron couplings are also predicted to be of a correct order of magnitude. (FR)

31469 NEUTRINO REACTIONS IN DEUTERIUM: THE AXIAL-VECTOR FORM FACTOR AND THE PSEUDOTENSOR FORM FACTOR. Mintz, S.L. (Department of Physical Sciences, Florida International University, Miami, Florida 33199). Phys. Rev. D 13: No. 3, 639-644 (1 Feb 1976).

The differential cross section, $d\sigma/d|q^2|$, for the reaction $\nu_\mu + d \rightarrow p + p + \mu^-$ is calculated for q^2 from threshold to -1.8 $(\mathrm{GeV}/c)^2$ as a function of the parameter M_A, the mass associated with the dipole fit to the axial-vector form factor F_A. A best fit of $M_A = 0.912 \pm 0.14$ GeV is found by comparison with experimental data. Possible contributions to the cross section from the presence of second-class currents are also calculated and the possible order of magnitude of the pseudotensor form factor F_T is discussed in view of experimental evidence. (auth)

31470 HEAVY-ELECTRON MASS AND *CP* VIOLATION IN A GAUGE MODEL. McKay, D.W. (University of Kansas, Lawrence, Kansas 66045). Phys. Rev. D 13: No. 3, 645-653 (1 Feb 1976).

A renormalizable [SU × *Y*] weak gauge model is studied in which spontaneous breakdown generates masses for all fermions except neutrinos and gauge bosons except the photon and at the same time destroys the original *P* and *CP* invariance of the Lagrangian. A connection between the heavy-electron-to-electron mass ratio and the size of *CP* violation is pointed out. A free-quark-model calculation of lowest order *CP* violation in the $K^0 \leftrightarrow \bar{K}^0$ mass matrix is used to test whether the model can accommodate the measured *CP* violation ($|\epsilon| = 2 \times 10^{-3}$) and the bound on heavy-lepton mass ($M_E > 1$ GeV). Assuming reasonable and consistent values of certain quark and Higgs-particle mass ratios, it is found that the model is consistent with known weak-interaction phenomenology if the mass of the heavy electron is *less* than about 6 GeV. The dominant leptonic decays of the heavy electron, *E*, are $E^- \rightarrow l^- + (\bar{\nu}^l_L) + \nu^e_R$, where $(\bar{\nu}^l_L)$ refers to the usual lepton ($l = e$ or μ) antineutrino but ν^e_R refers to a right-handed electron neutrino associated with the *E*. (auth)

31471 SU(3)-SYMMETRY BREAKING AND THE $K^0_2 \rightarrow \pi^0\gamma\gamma$ DECAY. Intemann, G.W. (Department of Physics, Seton Hall University, South Orange, New Jersey 07079). Phys. Rev. D 13: No. 3, 654-661 (1 Feb 1976).

The parity-conserving decay $K_2^0 \rightarrow \pi^0\gamma\gamma$ is studied using vector gauge fields with current mixing. The effects of SU(3) -symmetry breaking are included in the *PVV* vertices and the "simplest" $\Delta S = 1$ Hamiltonian (with a minimum of neutral currents) consistent with $\Delta I = 1/2$ is employed. The calculated decay rate is compared to previous theoretical estimates as well as to the current experimental upper limit for the decay. (auth)

31472 WEAK NONLEPTONIC DECAYS OF CHARMED HADRONS IN MODELS WITH RIGHT-HANDED CURRENTS. Branco, G.; Mohapatra, R.N. (Department of Physics, The City College of the City University of New York, New York, New York 10031); Hagiwara, T.; Sidhu, D.P. Phys. Rev. D 13: No. 3, 680-687 (1 Feb 1976).

We analyze the two-body weak nonleptonic decays of "charmed" pseudoscalar mesons to normal hadrons, in models with the most general structure for the right-handed currents. The structure of the left-handed part of the current is chosen in accordance with the Glashow-Iliopoulos-Maiani mechanism. Implications for the SPEAR charm search are analyzed. (auth)

31473 CABIBBO ANGLE AND QUARK MASS SPECTRUM. Zee, A. (Department of Physics, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 13: No. 3, 713-719 (1 Feb 1976).

We propose that the light quarks ρ, N, and λ are massless when the weak interaction is switched off. Because of the mass degeneracy between the N and λ fields the Cabibbo angle θ is undefined. When the weak interaction is switched on the light quarks manage to acquire masses by undergoing weak radiative processes involving heavy quarks (such as the charm quark), thus lifting the mass degeneracy. By identifying appropriate linear combinations of the N and λ fields as the physical N and λ states one in effect determines the Cabibbo angle. In this view, the orientation between the strong and weak interactions is controlled by the structure of the weak interaction. We assume strong interactions to be asymptotically free. The implementation of this program leads us to consider a "vector-like" weak-interaction theory which involves six quarks and right-handed currents and which has been discussed on phenomenological grounds elsewhere. (One feature of this program is that the smallness of the neutral kaon mass difference is ensured without further adjustments.) The Cabibbo angle θ and the mass ratio $m_{\bar{\nu}}/m_\lambda$ (which measures the extent of chiral symmetry breaking) are thus fixed in terms of some of the other parameters appearing in the theory, namely the mass ratio of the two positively charged heavy quarks and various mixing angles, for instance, the analog of θ in the right-handed current. These parameters are all measurable in principle. Our knowledge of θ and $m_{\bar{\nu}}/m_\lambda$ then enables us to make various predictive statements about these ratios and consequently the structure of the weak interaction at higher energies. Our point of view also leads naturally to an intimate connection between zero θ and exact chiral SU(2) symmetry. (auth)

31474 INCLUSIVE PION PRODUCTION BY *V* AND *A* NEUTRAL CURRENTS IN THE QUARK-PARTON MODEL. Gronau, M. (Department of Physics, Technion-Israel Institute of Technology, Haifa, Israel). Phys. Rev. D 13: No. 3, 720-724 (1 Feb 1976).

The process of deep-inelastic neutrino-nucleon scattering followed by the fragmentation of the possibly existing neutral current into pions is discussed. The quark-parton model allows for the consideration of characteristic effects of a general *V* and *A* neutral current. Charged-pion average multiplicities in ν and $\bar{\nu}$ scattering on an isovector target are found to be equal to each other and equal to the corresponding charged-current multiplicities. They are expected to be *x*- and *y*-independent and may be accurately calculated (within 10%) from recent electroproduction data. The structure parameters of the neutral current are related to neutral- to charged-current ratios of π^+ charge asymmetries. The importance of the measurements of these asymmetries is emphasized. (auth)

31475 POLARIZATION CORRELATIONS IN ELECTRON-POSITRON REACTIONS. Paschos, E.A. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 13: No. 3, 745-751 (1 Feb 1976).

We study the angular dependence of one-particle inclusive reactions with polarized electron-positron beams. It is observed that spin-1/2 and spin-1 partons, with zero anomalous magnetic moments, give the same angular distribution. The production of ordinary vector mesons, with zero anomalous magnetic moments, has also the same angular dependence and provides a candidate for a new component to the annihilation cross section. Present observations do not exclude such a component. A separate section elaborates on general properties of the quasielastic reaction for beams with arbitrary polarizations. (auth)

31476 NEW RESONANCES AND Γ ($V \rightarrow e^+e^-$). Kenny, B.G.; Peaslee, D.C. (Research School of Physical Sciences, The Australian National University, Canberra ACT. 2600, Australia); Nieto, M.M. Phys. Rev. D 13: No. 3, 757-759 (1 Feb 1976).

A new *V*-γ coupling constant relation is obtained. It rests on a previously derived relation and the modification involved in going from the Proca to the Duffin-Kemmer-Petiau formalism. This relation is validated by comparison of Γ ($V \rightarrow e^+e^-$) for ψ-ψ' and ρ-ω-ϕ mesons, which groups' masses differ greatly. It shows that ψ-ψ' are consistent with a (modified) Han-Nambu model. (auth)

31477 ISOSCALAR $\pi\pi$ RESONANCES AND CURRENT-ALGEBRA CONSTRAINTS IN $\psi' \rightarrow \psi + 2\pi$. Pasupathy, J. (Tata Institute of Fundamental Research, Homi Bhabha Road, Bombay 400005, India). Phys. Rev. D 13: No. 3, 764-766 (1 Feb 1976).

The difficulty of classifying three $I = 0$, low-lying scalar resonances [in particular ϵ (700)] within an SU(4) framework is stressed. Current-algebra constraints are worked out for the decay $\psi' \rightarrow \psi + 2\pi$; these lead to a matrix element disfavoring small pion momenta. A companion discussion is given of the decay $\eta' \rightarrow \eta\pi\pi$ and $\omega' \rightarrow \omega\pi\pi$. (auth)

31478 ISOSPIN-1/2 NUCLEON-RESONANCE PRODUCTION BY A *V*, *A* WEAK NEUTRAL CURRENT. Adler, S.L. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510); Karliner, I.; Lieberman, J.; Ng, Y.J.; Tsao, H. Phys. Rev. D 13: No. 5, 1216-1233 (1 Mar 1976).

We define a set of ratios characterizing the production of the isospin-1/2 resonances $D_{13}(1514)$ and $S_{11}(1505)$, as well as the isospin-3/2 resonance $P_{33}(1232)$, by electromagnetic and weak (charged and neutral) currents. Assuming the most general weak neutral current with *V*, *A* spatial structure, we calculate the matrix elements needed to extract the production ratios in three dynamical models for resonance production: the Born-approximation model, the nonrelativistic quark model, and the quark-bag model. For the special case of the Weinberg-Salam theory neutral current, the three models suggest that for $0 \leq \sin^2\theta_W \leq 0.5$ the ratios D_{13}/P_{33} and S_{11}/P_{33} observed in neutral-current π^0 or η production on a free nucleon target should be substantially smaller (by a factor of 2 to 4) than the corresponding ratios observed in charged-current π^0 or η production. We also attempt to predict the ratios D_{13}/P_{33} and S_{11}/P_{33} to be expected in charged-current production from the corresponding ratios observed in electroproduction, but here the three models do not agree, and so we can only state a wide possible range in which the values of the ratios may lie. We briefly discuss the charge-exchange corrections needed for comparison with experiments on complex nuclear targets; we find for an aluminum target that the reduction factors quoted above are halved, so that in neutral-current-induced reactions the ratios D_{13}/P_{33} and S_{11}/P_{33} are smaller by a factor of 1 to 2 than the corresponding ratios observed in charged-current–induced reactions. (auth)

31479 GAUGE THEORY OF WEAK INTERACTIONS WITHOUT CHARM. Sugawara, M. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 13: No. 5, 1284-1295 (1 Mar 1976).

We propose a new gauge theory of weak interactions in which we double the intermediate vector bosons instead of introducing charm. Assuming the baryon octet to be elementary, we derive the ΔS selection rules and the absence of the strangeness-changing neutral current. The Cabibbo angle is shown to be smaller than $\pi/4$. We infer from μ-e universality that μ-e asymmetry arises such that the mass of ν_e is zero but the mass of ν_μ is presumably not. We show that almost all the masses of baryons and leptons are calculable, which then makes it plausible that the ΔI selection rules and the isospin symmetry of hadrons follow as further consequences. One experimental test of this theory is to find one of the two Higgs scalars which both decay into 2μ, but not appreciably into any other charged particles, with the lifetime roughly that of π^0. (auth)

31480 NEW WEAKLY DECAYING PARTICLES AND SUBNUCLEONS. Yock, P.C.M. (Department of Physics, University of Auckland, Auckland, New Zealand). Phys. Rev. D 13: No. 5, 1316-1321 (1 Mar 1976).

A model of heavy, highly electrically charged hadron constituents termed "subnucleons" was proposed previously. Recently experimental evidence has been obtained for new particles with lifetimes $\sim 10^{-12}$–10^{-14} sec. Here, a possible classification for them is given in terms of the above-mentioned model. The most prominent of the new particles is predicted to have a mass slightly below 990 MeV and to decay into $\pi^+\pi^0$, $\pi^+\eta$, $e\nu$, and $\mu\nu$. Experimental searches for highly electrically charged subnucleons are also discussed. It is pointed out that a very recently observed highly ionizing particle of a Berkeley-Houston group may be a subnucleon. Scaling, e^+e^- interactions, and the J and ψ resonances are briefly discussed. Comments on quarks, charm, the quark-parton model, and monopoles are also made. (auth)

31481 MASS MIXING AND THE CABIBBO ANGLE. Yang, T.C. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 13: No. 5, 1322-1326 (1 Mar 1976).

Spontaneous symmetry breaking does not always induce the Cabibbo form of weak currents. The latter with the renormalizability argument in general constrains the Cabibbo angle. An example is given which gives $\tan\theta = (\sqrt{3}-1)/(\sqrt{3}+1)$, in agreement with experiment. (auth)

31482 FERMION CURRENTS IN A UNIFIED MODEL OF QUARKS AND LEPTONS. Kim, B.R. (III. Physikalisches Institut, Technische Hochschule Aachen, Aachen, West Germany). Phys. Rev. D 13: No. 5, 1454-1461 (1 Mar 1976).

We discuss a natural way of introducing fermion currents in a unified model of quarks and leptons. The weak neutral current of our model is, in low-energy approximation, equal to the sum of the Weinberg-Salam neutral current with $\theta = 0$ (where θ is the Weinberg angle) and fermion currents. (auth)

31483 SYMMETRIC EIGHT-QUARK AND EIGHT-LEPTON MODEL OF WEAK INTERACTIONS. Cung, Vu.K.; Kim, C.W. (The Johns Hopkins University, Baltimore, Maryland 21218). Phys. Rev. Lett. 36: No. 10, 536-539 (8 Mar 1976).

We present a gauge model which is similar to the model recently proposed by Suzuki with eight quarks and eight leptons, but which is more symmetric in quark-lepton assignment. Consistency with experimental data on the dimuon events in neutrino and antineutrino reactions is discussed. (auth)

31484 NEW QUARK MODEL WITH WEAK TRIPLET. Suzuki, T.; Hori, S.; Yamada, E.; Yamanashi, K. (Department of Physics, Kanazawa University, Kanazawa 920, Japan); Abe, Y. Phys. Rev. Lett. 36: No. 11, 562-565 (15 Mar 1976).

We propose a new anomaly-free quark model with weak isotriplets for quarks. The $\Delta I = 1/2$ enhancement may be accounted for, the requirement of Golowich and Holstein being satisfied. There arises a mixing of left-handed charmed quarks with left-handed nucleonic ones which essentially gives an over-all explanation of neutral-current effects, inclusive y distribution, the ratio $\sigma^T(\bar{\nu}d)/\sigma^T(\bar{\nu}d)$, and copious dilepton events in ν and $\bar{\nu}$ reactions. (auth)

31485 COMMENTS: EFFECT OF HEAVY LEPTONS ON CHARMED-PARTICLE DECAYS. Karliner, I. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. Lett. 36: No. 13, 759-760 (29 Mar 1976).

The helicity argument applied to purely leptonic decays of heavy pseudoscalar mesons (F,D) gives a high branching ratio Γ (F,$D \to \nu +$ heavy lepton (L))/Γ (F,$D \to \mu + \nu$). The branching ratio Γ ($F \to L + \nu$)/Γ ($F_{\mu 3}$ and F_{e3}) is estimated to be 5–50% for the F_D dominant η decay mode, and Γ ($F \to L + \nu$)/Γ ($F \to$ all) is 0.3 to 1.5%. (auth)

Strong (General)

Refer also to abstract 30549.

31486 (ITP-74-95-E) LARGE TRANSVERSE MOMENTA IN THE HYDRODYNAMICAL MODEL OF MULTIHADRON PRODUCTION. Gorenstein, M. I.; Zinovjev, G. M.; Pavlenko, O. P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 8p. INIS.

The problem of large transverse momenta of secondaries is considered in frame of hydrodynamical model of multihadron production. The "evaporation" mechanism is suggested. In accordance with it large transverse momenta can appear as a result of a particle emission during the stage of hydrodynamical system expansion at temperature $T > T_{cr} \simeq \mu$ (μ is the mass of χ-meson). Calculation is performed in the one-dimensional approximation. Comparing the results with the experimental data one can make some conclusions concerning possible equation of state of hadron matter. (auth)

31487 BEHAVIOR OF TOTAL CROSS SECTIONS OF HADRONS AT HIGH ENERGIES. Babaev, Z. P.; Belogorlov, E. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yad. Fiz.; 22: No. 6, 1206-1216(Dec 1975). (In Russian).

The data on total cross sections of hadrons at high energies are analyzed in the model of Froussart saturation and in the geometrical scaling model. The conclusion is made that the available data can be fitted by various models essentially different in the dynamics of the interaction. However, the high energy ($\sim 10^3$ GeV) predictions strongly differ one from another. The experimental data are as well analyzed with respect to the consequences from dynamical symmetries. It is shown that the most part of the relations between total cross sections are better satisfied when the energy increases. (auth)

31488 CRITIQUE OF THE REGGEIZED DECK MODEL. Berger, E. L. (Argonne National Lab., IL). pp 35-64 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (Eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R–34; CONF-750237-.

A detailed analysis is presented of the Reggeized pion exchange Deck model for processes of the type ap yields A*N yields (a*pi)N, where a equals pi, K, or nucleon and a* equals rho, K*, or DELTA. Predictions of the model for both production and decay properties of the low mass system A* yields (a*pi) are derived and contrasted with data. Diffractive as well as charge exchange reactions are treated. The role of pion exchange in generating (a*pi) enhancements near threshold and their properties is examined from several points of view. Characteristic exchange effects and quantum number properties (e.g., crossovers) of the pion exchange Deck graph are shown to be verified in the data, but this graph alone is inadequate. The failures all point to the need for a second graph, having a* exchange properties. The contribution of a* exchange is roughly equal to that of the pi-exchange graph. (auth)

31489 DIFFERENT APPROACH FOR CHARGED MULTIPLICITY DISTRIBUTIONS IN HADRON–HADRON COLLISIONS. Kam, C. H.; Low, H. B.; Phua, K. K. (Nanyang Univ., Singapore). Nuovo Cim., 31A: No. 2, 356-364(21 Jan 1976).

An approach for charged multiplicity distributions which is based on the fragmentation process with pionization always present is examined. Good fits were obtained for pp collisions of P_{lab} from 12 to 300 GeV/c. Prediction of the charged multiplicity distribution at 1500 GeV/c is also given. The third moment f_3 should cross into the positive region. (auth)

31490 ENERGY DEPENDENCE OF ELASTIC SCATTERING. Kroll, P. (Univ., Wuppertal, Ger.). Czech. J. Phys.; B26: No. 1, 96-101(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

The energy dependence of elastic scattering is discussed, and it is shown that it is compatible with geometrical scaling of the inelastic overlap function. The importance of the real part of the elastic amplitude for the energy dependence is emphasized. (auth)

31491 ASYMPTOTIC CORRELATIONS BETWEEN TOTAL CROSS SECTIONS AND FORWARD SCATTERING AMPLITUDES. Fischer, J. (Inst. of Physics, Prague); Kolar, P.; Vrkoc, I. Czech. J. Phys.; B26: No. 1, 86-91(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

Recent experimental results on hadron–hadron total cross sections and on the real parts of forward scattering amplitudes

are discussed on the basis of rigorous model-independent theory. Some consequences of the asymptotic theorems obtained recently are presented. (auth)

31492 PRECISION WITH WHICH THE PHASE OF THE FORWARD ELASTIC AMPLITUDE CAN BE DETERMINED IN COULOMB INTERFERENCE MEASUREMENTS. Ekelof, T. (CERN, Geneva). Nuovo Cim., A; 31A: No. 3, 505-518(1 Feb 1975).

The error in the phase ρ was calculated by fitting the Coulomb interference expression to pre-calculated data on $(d\sigma/dt)_{elastic}$. The error is obtained from the error matrix of this fit. The variation of the error with the following parameters was studied: the total number of events, the error in the absolute normalization in $d\sigma/dt$, the error in the hadronic amplitude parameters and the upper and lower limits of the range over which $d\sigma/dt$ is measured. One important conclusion is that the precision in the absolute normalization is of critical importance for the precision in ρ. (auth)

31493 CORRELATIONS BETWEEN HADRONS WITH LARGE TRANSVERSAL MOMENTA IN FRAGMENTATION REGION. Shoikhet, V. Kh. (Tbilisi State Univ., USSR). Yad. Fiz.; 23: No. 1, 180-190(Jan 1976). (In Russian)

Bi-inclusive and the two-particle correlations are calculated for production of hadrons with large opposite transversal momenta in the fragmentation region. The calculations are performed on basis of the Landshoff–Polkinghorne covariant parton model (with the ladder kinematics), while it is assumed that the hadrons with large tranverse momenta are "decay products" from partons with isolated rapidities and large transverse momenta that decay into hadron showers. It is shown that in fragmentation region the present model predicts very characteristic correlations, comparison of which with experimental data is of certain interest. (auth)

31494 QUANTUM RESONANCES IN STATIONARY GEOMETRIES. Damour, T. (Joseph Henry Physical Labs., Princeton, NJ); Deruelle, N.; Ruffini, R. Lett. Nuovo Cim.; 15: No. 8, 257-262(21 Feb 1976).

Some of the results presented previously are used to show by an explicit example how in a stationary geometry or in the field of a collapsed object endowed with electromagnetic structure resonance states with $\Gamma < 0$ (growing with time) can be found. A spin-0 boson field of a given mass and charge in a Kerr–Newman geometry is considered. (JFP)

31495 LAGRANGIAN MODEL OF COLOR BRIGHTENING. Krolikowski, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 23: No. 12, 1301-1306(1975).

A simple Lagrangian model is constructed where electromagnetic coupling of hadronic color degrees of freedom gets stronger when momentum transfer increases. (auth)

31496 SOLVABLE MODEL OF DIFFRACTIVE DISSOCIATION OF HADRONS. Andreev, I. V. (Lebedev Inst. of Physics, Moscow). Yad. Fiz.; 23: No. 1, 198-206(Jan 1976). (In Russian)

A dynamical model of diffractive dissociation of hadrons in the small excitation mass region is constructed. The model can be used to make explicitly all calculations. The physical states in the model are constructed from bare states so that the stable hadrons arise as a consequence of rearrangement of the mass spectrum of the bare states in an analogy with superconductive state. The model can qualitatively describe the main features of the data on the diffractive dissociation and allows one to get information on hadron internal structure and on the interaction of the excited system being produced. In particular, the model predicts a decrease of the interaction cross section of the system being produced when its mass is increasing. (auth)

31497 STATE EQUATION OF EXCITED, STRONGLY PRESSED HADRONIC MATTER. Kalinkin, B. N.; Shmonin, V. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 23: No. 1, 239-241(Jan 1976). (In Russian)

The possibility is discussed of obtaining information on the state equation of excited strongly pressed hadronic matter using the data on multiple production in a dense nuclear matter. (auth)

31498 SUMMARY TALK. Glashow, S. L. (Harvard Univ., Cambridge, Mass. (USA)). pp 439-447 of High Energy Neutrino Physics, Paris, March, 18-20, 1975. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on high energy neutrino physics; Paris, France (18 Mar 1975).

A new and by now standard theory of elementary particle physics in which hadron spectroscopy is just quark chemistry is summarized. Emphasis is put on some ingredients of the theory: color, fractional quark charges, exact color (SU_3) theory with gluons, asymptotic freedom and infrared gauge theory, charm and the new hadrons J or ψ. (FR)

31499 BOUNDS ON THE IMAGINARY PARTS OF SPIN-0-SPIN-1/2 PARTICLE SCATTERING AMPLITUDES FROM EXPERIMENTAL DATA AND LIMITED USE OF UNITARITY. Sakmar, I.A.; Chan, S.K. (Applied Mathematics Department, University of Western Ontario, London, Ontario, Canada). Phys. Rev. D 13: No. 3, 603-615 (1 Feb 1976).

Bounds on the moduli and relative phase of the spin-0–spin-1/2 particle scattering amplitudes are used in the unitarity relation to find upper bounds for the imaginary parts of the spin-nonflip and spin-flip amplitudes. (auth)

31500 HIGH-ENERGY AVERAGE CHARGED MULTIPLICITIES FROM NUCLEI IN A REGGE-CALCULUS MODEL. Cutler, R.T.; Snider, D.R. (Department of Physics, University of Illinois, Urbana, Illinois 61801). Phys. Rev. D 13: No. 5, 1504-1506 (1 Mar 1976).

Lehman and Winbow have used a Gribov Reggeon-calculus approach to derive expressions for average charge multiplicities in high-energy scattering off nuclei. They find the multiplicity to be $n = bY + f(A)$, where b is independent of A. We show that a reasonable modification of their model yields $n = bA^{1/3}Y + g(A)$, where b is known. We find that this expression agrees with experimental data on dn/dY (where $Y = \ln s$) better than that of Lehman and Winbow, and agrees as well as the energy flux model of Gottfried. (auth)

31501 REPLY TO "HIGH-ENERGY AVERAGE CHARGED MULTIPLICITIES FROM NUCLEI IN A REGGE-CALCULUS MODEL". Lehman, E.S.; Winbow, G.A. (Daresbury Laboratory, Daresbury, England). Phys. Rev. D 13: No. 5, 1507-1508 (1 Mar 1976).

We reply to the criticisms of our work by Cutler and Snider, taking account both of recent data on hadron-nucleon scattering as well as of theoretical agruments. (auth)

31502 SHIELDED POMERON MODEL FOR HIGH-ENERGY CROSS SECTIONS. Paranjape, S. (The Enrico Fermi Institute and the Department of Physics, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. D 13: No. 5, 1509-1512 (1 Mar 1976).

Starting with a shielding mechanism which makes hard Regge surfaces compatible with two-particle unitarity in the t channel, we present a model for the Pomeron and its associated shielding cut. The model provides a unified description of pp, πp, and Kp scattering while conforming to the usual tenets of factorization and exchange degeneracy. (auth)

31503 SLOPE RENORMALIZATION OF THE ONE-LOOP PLANAR STRING DIAGRAM. Roth, R. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 13: No. 6, 1614-1620 (15 Mar 1976).

It has been previously shown that for the number of dimensions $d < 25$, the one-loop planar string diagram is simply a multiplicative (coupling constant) renormalization of the Born term. It is shown here that for $d = 25$ or 26 the extra divergent term gives, in addition to a further multiplicative renormalization, a renormalization of the slope of the Regge trajectories. (auth)

31504 TWO-DIMENSIONAL YANG-MILLS THEORY: A MODEL OF QUARK CONFINEMENT. Callan, C.G. Jr.; Coote, N.; Gross, D.J. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 13: No. 6, 1649-1669 (15 Mar 1976).

We analyze the structure of two-dimensional Yang-Mills theory as a model of quark confinement. 't Hooft's solution, in the large-N limit, is extended to investigate the consistency and the properties of the model. We construct the hadronic color singlet bound-state scattering amplitudes. We show that they are unitary, that colored states cannot be produced, and that all long-range interactions are absent. Current amplitudes are constructed, and we show that the theory is asymptotically free and the quark mass sets the scale of mass corrections. The properties of bound states of heavy quarks are discussed, and a dynamical basis for the Okubo-Zweig-Iizuka rule is suggested. We show how confinement can occur with an infrared prescription that leads to finite-mass quarks which decouple from physical states and discuss the dependence of gauge-variant amplitudes on the cutoff procedure. Higher-order effects in $1/N$ are shown not to change the qualitative features of the model. (auth)

31505 SEMICLASSICAL DYNAMICS OF THE "SLAC BAG". Giles, R.C. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 13: No. 6, 1670-1689 (15 Mar 1976).

It is shown that the classical thin-shell states of the "SLAG bag" model may be described, in a strong-coupling limit, by the motions of a surface of constant surface tension upon which free quark fields propagate. Classical static and nonstatic solutions in two and three

space dimensions are discussed. It is found that such objects are very easily deformed. The implications for excited state levels in and the quantum mechanics of a model of hadrons based on such states are discussed. (auth)

31506 QUANTUM DYNAMICS OF A QUARK-BINDING BUBBLE IN TWO SPACE AND ONE TIME DIMENSIONS. Giles, R.C.; Tye, S.H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 13: No. 6, 1690-1703 (15 Mar 1976).

We discover that the set of coupled equations of motion of the quark-binding bubble model can be solved exactly and completely in two space and one time dimensions. In this three-dimensional Minkowski space, the bubble is equivalent to a closed string with massless quarks trapped on it. The integrability of the equations follows from the special simplicity of the geometry of two-dimensional surfaces. From the set of all classical solutions, a Poincaré-invariant quantum system is explicitly constructed. The resulting spectrum is free of ghosts. (auth)

31507 ASPECTS OF QUARK CONFINEMENT. Bose, S.K.; Jabs, A.; Müller-Kirsten, H.J.W.; Vahedi, N. (Department of Physics, University of Kaiserslautern, 6750 Kaiserslautern, Germany). Phys. Rev. D 13: No. 6, 1704-1711 (15 Mar 1976).

Various aspects of quark confinement are considered. First we show in the context of potential theory that steep confinement potentials lead to mass formulas which are similar to those obtained for confining boundary constraints imposed on the free quark motion. We then consider the field-theoretic model of a scalar quark field which is subjected to a strong self-coupling in a finite domain of a three-dimensional lattice space. We show that the strong self-coupling prevents the quark field from spreading easily, but that by itself it does not suffice to confine quarks. A confinement constraint or equivalent potential is still required. We also show that the mass of a single quark grows with increasing self-coupling and becomes infinite in the continuum limit (thus necessitating the use of the lattice). (auth)

31508 MULTIPERIPHERAL MODELS: A SELF-CONSISTENT FIELD APPROACH. Steinhoff, J. (Department of Physics, McGill University, Montreal, Quebec, Canada). Phys. Rev. D 13: No. 6, 1712-1726 (15 Mar 1976).

A multiperipheral amplitude with elementary particle propagators is written in a form containing only pair-wise finite-range rapidity-dependent terms, and transverse-momentum terms (in the central region). A potential is defined that represents, on the average, the effect on a particle of all the other particles. This potential confines each particle to a certain region of rapidity (with respect to nearby particles on the chain), and transverse momentum. The potential is shown in turn to result from the averaged effects of all the other particles, each confined by the same potential. It is argued that the approximation becomes exact for high densities (large coupling constants); and transverse momentum and multiplicity distributions, as well as Regge exponents, are computed in this limit for three cases: I. rapidity order corresponding to chain order; II. no rapidity restrictions but the same order on both sides of the multiperipheral ladder; III. no restrictions (all crossed rungs). The results are seen to be quite different in each case. (auth)

31509 QUARKS AT THE ENDS OF THE STRING. Bars, I. (Department of Physics, Yale University, New Haven, Connecticut 06520); Hanson, A.J. Phys. Rev. D 13: No. 6, 1744-1760 (15 Mar 1976).

We develop a technique for attaching quark quantum numbers to world lines joined by relativistic strings. We are able to describe spin-0 and spin-1/2 U(n) -symmetric quarks attached to world lines. One spin-1/2 theory based on the Dirac equation yields a classical particle with helical motion, interpretable as *Zitterbewegung*. Another spin-1/2 model has no helical motion, but yields an algebra resembling that of supersymmetry. Motivated by duality diagrams and some general properties of quark-gluon models, we then construct quark-string models of mesons and baryons. The analysis of the meson model with unequal quark masses implies a stringlike spectrum with broken trajectory intercepts. A simple baryon model suggests a dynamical reason for diquark configurations in the lowest states. Physical weak and electromagnetic currents for the quark-string system follow from a minimal-coupling scheme as in gauge field theories. (auth)

31510 UNITARY PLANAR SINGLE-LOOP AMPLITUDE IN THE FERMION DUAL RESONANCE MODEL. Kaul, R.K. (Department of Physics and Astrophysics, University of Delhi, Delhi-110007, India). Phys. Rev. D 13: No. 6, 1761-1768 (15 Mar 1976).

The unitary planar single-loop amplitude in critical dimensions of space-time with only the physical states propagating internally in the loop has been calculated for Ramond's fermion model in the manner of Brink and Olive using the physical-state projection operator for critical dimensions written by Corrigan and Goddard recently. The results differ from those obtained with an unprojected propagator by a factor involving certain partition functions. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 31308.

31511 (INIS-mf-1884) THE TENSOR CURRENT DIVERGENCE PRINCIPLE AND ITS APPLICATION TO THE BEHAVIOR OF SPIN 1 MESONS. do Amarante, J. A. A. (Universidade Estadual de Campinas (Brazil). Instituto de Fisica). 1973. 51p. (In Portuguese). INIS.

A critical analysis is made of the serious difficulties associated with the old Partial Conservation of the Tensor Current (PCTC) proposal and it is shown how difficulties may be eliminated by a different hypothesis about the behavior of the divergence of the tensor current of the group U_{12}. This hypothesis will be named the Tensor Current Divergence Principle (TCDP). Through the use of a model of interacting quarks and vector mesons, modified by the introduction of a magnetic moment type of interaction, a relation among the divergence of the tensor current, the vector current and the source current of vector mesons is obtained and then abstracted to the real world. In deriving this relation the vanishing of renormalization constants is used as a dynamical criterion to characterize composite particles. The TCDP relation predicts the universality of the vector mesons "electric" form factor to be exactly valid only in the limit of $q^2 = 0$; this is a physical consequence of the universal electric coupling of photons. The "magnetic" form factors, however, will obey very definite, non universal, relations in good agreement with the experimental data available. The theoretical importance of this new principle arises because it allowed a physical interpretation to the only operation of the group U_{12}, its tensor current, still lacking a consistent physical meaning. (auth)

31512 AZIMUTHAL CORRELATIONS IN HIGH-ENERGY MULTIPARTICLE PRODUCTION. Fridman, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Z. Phys., A; 274: No. 4, 395-397(Oct 1975).

7 refs.

Some features of the two-particle correlation phenomena, studied by means of azimuthal angle variables, are discussed. Assuming Gaussian forms for the single transverse momentum distributions, the two-particle correlation is described with only one parameter. The influence of the kinematical constraints on the proposed correlation parameter is discussed, using a limited transverse momentum phase-space model. (DE)

31513 CORRELATION BETWEEN NEUTRAL AND CHARGED PIONS IN QUARK MODEL. Guman, V. N.; Shekhter, V. M. (Leningrad Inst. of Nuclear Physics). Yad. Fiz.; 22: No. 6, 1237-1247(Dec 1975). (In Russian).

Dependence of the average π^0 number upon the number of associated negative particles is computed in the framework of quark model. The results reproduce correctly both the linear shape of such dependence and magnitude of the slope parameter. The model does not make use of any free parameters. (auth)

31514 QUARK FRAGMENTATION FUNCTIONS IN HADRONIC AND DEEP INELASTIC SINGLE PARTICLE INCLUSIVE PROCESSES. Flume-Gorczyca, B. (Deutsches Elektronen-Synchrotron, Hamburg). Acta. Phys. Pol., Ser. B7: No. 2, 127-132(Feb 1976).

In the framework of Feynman's quark-parton model for inclusive electroproduction and quark model of Ezawa, Maharana and Miyazawa for hadronic inclusive processes, relations between invariant cross sections for electroproduction of pions and purely hadronic production of pions in the beam fragmentation regions are derived. They are satisfied by data. The ratio of parton fragmentation functions $\eta = D_u^{\pi^+}(z)/D_d^{\pi^+}(z)$ is estimated from purely hadronic processes independently from the parton model. (auth)

31515 SOME BOUNDS ON PION–PION SCATTERING AMPLITUDES AND THEIR APPLICATIONS. Chung, B. K. (International Centre for Theoretical Physics, Trieste, Italy); Vinh Mau, R. Nuovo Cim., 31A: No. 2, 193-206(21 Jan 1976).

If one uses the method introduced by Meiman and further developed by Martin, together with unitarity, crossing symmetry, and analyticity, upper and lower bounds to the $\pi^0\pi^0$ scattering amplitudes inside the Mandelstam triangle are obtained in terms of the scattering lengths. These bound are used to set a lower bound to the S-wave scattering length a_0 and also upper and lower bounds to the renormalized pion coupling constant λ. In terms of the D-wave scattering length a_2, the results are $a_0 \geq -23.18\sqrt{a_2} + 129.07\, a_2$ and $-7.71\sqrt{a_2} \leq \lambda \leq 7.71 \cdot \sqrt{a_2} + 2.5\, a_2$. For $a_2 = 7 \cdot 10^{-4}$ they yield $a_0 \geq -0.52$ and $|\lambda| \leq 0.20$, where the pion mass is set equal to unity. (auth)

31516 INTRODUCTORY REMARKS: QUARKS, MESONS, AND THREE-PARTICLE PHASE SHIFT ANALYSIS. Hey, A. J. G.

(Univ. of Southampton, Eng.). pp 3-5 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

The interest in three-particle phase shift analysis derives from the hope that it can answer many important questions for quark schemes of hadrons. Quark model predictions for meson spectroscopy are briefly outlined and some of the urgent problems in meson spectroscopy that it is hoped may be answered by a better understanding of three phase shift analysis applied to meson systems are listed. (UK)

31517 THREE MESON PARTIAL WAVE ANALYSIS: BASIC THEORY. Jones, G. T. (Univ. of Birmingham, Eng.). pp 9-14 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

The basic theory of two meson partial wave analysis leading to that of three meson partial wave analysis is considered. Assumptions which must be made in order to reduce the number of unknown parameters to a reasonable amount are suggested. The density matrix and amplitude analysis approaches are discussed. (UK)

31518 RESULTS OF 3π ANALYSES BY THE ILLINOIS GROUP. Kruse, U. E. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). pp 21-28 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

Partial wave analyses on the 3π system from bubble chamber data are presented for beam moments between 5 and 25 GeV and from spectrometer data for beam moments of 23, 25 and 40 GeV/c. The resolution of the 3π system into partial waves and the A_2, A_1, and A_3 properties are described. Results from a study of a Reggeized Deck model are presented, and results from an examination of a Regge amplitude for A_2 production are given. (UK)

31519 CORRECTIONS TO THE ISOBAR MODEL FOR THREE HADRON FINAL STATES. Aitchison, I. J. R. (Univ. of Oxford). pp 81-95 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

It is shown that in the analysis of systems decaying into three mesons, in the case in which several pairs interact strongly, the complete amplitude for the decay, obtained in the isobar model approximation, does not satisfy two body unitarity in the final state. Two approaches are considered to satisfy the sub-energy (two body) discontinuity relations by means of a correction function; the K-matrix method and the dispersion relation method. The application of the K-matrix sub-energy unitarization approach to the A_1 problem is also discussed. A model is introduced that not only satisfies all the requirements of sub-energy unitarity but also satisfies three-body unitarity if the C_i's are taken to be constant, provided the three particle → three particle amplitude is given purely by pairwise scattering terms. If one wishes to include other three body processes, still within the general framework of the isobar model, one can introduce "intrinsic" isobar scattering amplitudes A_{ij}; the functions C_i then have a three-body cut in m^2, their discontinuities across which are related to the A_{ij}. The A_{ij} themselves also satisfy quite simple discontinuity relations across the three-body cut. These m^2 discontinuity relations can be implemented in a phenomenological way by a K-matrix parameterization, or, used in dispersion relations, as the basis of a dynamical model of the three-body system. (UK)

31520 THEORETICAL EXPRESSION FOR THE $\rho^0-\rho^\pm$ MASS DIFFERENCE. Madore, J. (Univ., Paris). Lett. Nuovo Cim.; 15: No. 6, 185-188(7 Feb 1976).

A generalization of the sigma model was previously proposed which is invariant under a local transformation of the chiral group SU(2) × SU(2). The intrinsic symmetry of this model is broken by introducing electromagnetic interactions. The intrinsic symmetry is broken in a way which conserves local gauge invariance. The manner of symmetry breaking is vaguely analogous to the way in which the Lorentz symmetry of space–time is broken in the presence of matter. The $m_{\rho^0}-m_{\rho^\pm}$ is found to be 2.81 MeV. (JFP)

31521 THEORETICAL IMPLICATIONS OF THE NEW PARTICLES. Harari, H. (Weizmann Inst. of Science, Rehovot, Israel). pp 317-353 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

The discussion of the theoretical implications of the new particles includes the experimental PSI spectrum on August 22, 1975, the hadronic nature of the psi particles, the psi states and the threshold in R, the possibility of the psi possessing a new quantum number which may be colored, the psi particles as colorless bound states of heavy quarks, qualitative features of processes involving psi particles, how to test the Zweig–Iizuka rule, does one need new quarks, psi spectroscopy, the missing decays of psi' (3700), the elusive charmed mesons and their predicted properties, could all of the new physics be due to charm, could the new physics, except for the heavy lepton pairs, be due to charm, a possible A (V + A) current, and future possibilities. (JFP)

31522 CASE FOR COLOR. Feldman, G.; Matthews, P. T. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 31A: No. 3, 447-486(1 Feb 1975).

A possible explanation of the psi-particles is presented in the context of Han–Nambu color theory. The strong group is taken to be SU/sub 3'/ x SU/sub 3''/ and it is proposed that there are vector mesons in the (1, 1), (8, 1), (1, 8) and (8, 8) representations. It is assumed that both SU_3 subgroups break to $SU_2 \times U_1$, which implies a fourth psi-particle coupled directly to the photon. A provisional parametrization on the basis of Okubo-type mass formula suggests a mass for this particle about 4.8 GeV/c^2. The theory also predicts charged colored vector mesons rho^{+-}/sub C,D/ with the same mass as psi (3.1) and psi (3.7) and colored mesons K^{*+-0}/sub C,D/ with masses approximately 3.9 GeV/c^2 and 4.5 GeV/c^2. Colored pseudoscalar mesons pi/sub C,D/ have decay properties similar to rho/sub C,D/. They do not couple directly to the photon but are accessible from $psi_{1,2}$ by radiative transitions and provide a possible explanation of the new state at 3.5 GeV/c^2. Also a renormalizable theory of weak and electromagnetic interactions with hadronic currents with the necessary group-theoretic and observed hypercharge-changing properties is developed in this framework. These requirements together with "universality" are sufficient to determine the theory almost uniquely. Its implications for colored particles are examined, and it is shown that the only long-lived colored vector meson is K^{*+}/sub C/ (or rho^{+}/sub C/ in the alternative version) with mean life about 10^{-13} s. (auth)

31523 PROBLEMS IN THE PHENOMENOLOGICAL ANALYSIS OF CROSS SECTION DIFFERENCES $\sigma_{pp}-\sigma_{pn}$ AND $\sigma_{\bar{p}p}-\sigma_{\bar{p}n}$. Bouquet, A. (Univ., Paris); Diu, B.; Leader, E.; Nicolescu, B. Nuovo Cim., A; 31A: No. 3, 411-422(1 Feb 1975).

It is shown that uncertainties in the exact value of the Glauber correction make it virtually impossible to deduce any significant conclusions about the asymptotic behavior of the $\sigma_{\bar{p}p}-\sigma_{\bar{p}n}$ and $\sigma_{pp}-\sigma_{pn}$ cross section differences, if only data on pp, pd, $\bar{p}p$ and $\bar{p}d$ collisions are used. Nevertheless it can be demonstrated that the imaginary part of the ρ exchange amplitude is basically Regge behaved. If, on the other hand, neutron beam data on σ_{np} are used, it can be shown that the imaginary part of the A_2 exchange amplitude contains a non-Regge, growing, asymptotic component, reminiscent of that found in the I = 0 symmetric amplitude. (auth)

31524 CHARACTER OF BARYON EXCHANGE AT HIGH ENERGIES. Ginzburg, I. F.; Perlovskii, L. I. (Inst. of Mathematics, Kiev). Yad. Fiz.; 23: No. 1, 230-238(Jan 1976). (In Russian)

Data on backward πN scattering at high energies, as well as theoretical considerations, indicate an importance of exchange by an elementary (nonreggeized) baryon. On this basis a number of qualitative and quantitative predictions are presented for the binary reactions $\pi^+p \to p\pi^+$, $pp \to \pi d, \ldots$ for inclusive reactions $pp \to \pi+\ldots$, $\Sigma p \to \pi+\ldots$ at low values of the missing mass, as in the region nearest to the baryon pole, for the $\bar{p}p$ correlations in the multiple production. (auth)

31525 REAL PART OF THE FORWARD p-n AND $\bar{p}$-n SCATTERING AMPLITUDES IN THE HIGH ENERGY REGION. Baranowski, S. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 23: No. 12, 1287-1293(1975).

Real parts of the forward p-n and $\bar{p}$-n scattering amplitudes in the high energy region were calculated. To this end the expansion of the dispersion integral from the unphysical region in a power series was performed. In the asymptotic region a possibility of rising total cross sections was taken into account. A comparison of the obtained results with those of earlier works reveals that the Re/Im dependence on energy is reasonable within the high energy region. (auth)

31526 P-WAVE SCATTERING LENGTH SUM RULES FOR THE $\pi\pi$ SYSTEM. Rechenberg, H.; Robertson, D.; Wit, R. (Max-Planck-Institute for Physics and Astrophysics, Munich). Acta Phys. Pol., Ser. B7: No. 3, 221-224(Mar 1976).

Sum rules for the I = 1 P-wave $\pi\pi$ scattering length a_1^1 are derived for the modulus and inverse of the scattering amplitude. These nonlinear dispersive sum rules depend crucially on the positivity of the amplitudes' imaginary part. Numerical examples are given which seem to prefer larger values of a_1^1. Comparison is made to the commonly used relations for a_1^1. (auth)

31527 PION SPECTRUM IN DECAY OF psi'(3.7) TO psi(3.1). Schwinger, J.; Milton, K. A.; Tsai, W. Y.; DeRaad, L. L. Jr. (Univ. of California, Los Angeles). Proc. Natl. Acad. Sci. U.S.A.; 72: No. 11, 4216-4217(Nov 1975).

The decay of psi' yields psi + pi pi is described by a chiral epsilon model. The general features of the observed dipion spectrum are well reproduced. Comparison with the hadronic decay rho' yields rho + pi pi indicates that the psi'psi epsilon coupling is relatively suppressed by a factor approximately 10^{-2}. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 31315, 31331, and 31599.

31528 DUALITY STRUCTURE OF DIFFRACTION DISSOCIATION. II. Hidaka, K. (Tokyo Univ.). Lett. Nuovo Cim.; 15: No. 7, 221-227(14 Feb 1976).

The recent data on the process $K^-p \to pX$ and those on $pp \to pX$, and $\pi^-p \to pX$ are studied. If one assumes the factorization of triple-Regge terms, a test is made of whether the data favor the normal or abnormal situation. It is concluded that the extreme abnormal duality scheme of previous work is ruled out by the analysis at least at $t = -0.25(GeV/c)^2$. On the other hand the normal duality scheme is quite compatible with the experimental data at the same t-point in the diffractive process $K^-p \to pX$ as well as in the processes $pp \to pX$ and $\pi^-p \to pX$, though the possibility of the mixed duality suggested previously is not excluded by this analysis. (JFP)

31529 QUARK CONFINEMENT: HADRONS AS "STRONG BLACK HOLES." Recami, E. (Univ., Catania, Italy); Castotina, P. Lett. Nuovo Cim.; 15: No. 10, 347-350(6 Mar 1976).

A check is made as to whether quarks can be confined in hadrons, e.g., into nucleons, as a consequence of the fact that hadrons might be considered as strong black holes (as black holes due not to a gravitational field interacting with gravitational charges (masses), but to the strong field interacting with the strong charges carried by quarks). It is assumed that the inner spacetime of hadrons is essentially affected only by the strong field; in this respect out of all the quark properties, only the quark strong charges are relevant, which are all expected to be identical. Quark masses are assumed to be all identical too. The result seems to suggest that in nucleons the quarks remain confined between the two spheres respectively with inner radius $R_1 \simeq 10^{15}$ cm and outer radius $R_2 \simeq {}^{-13}$cm. A priori, on the contrary, leptons and photons can escape from the strong black hole. (JFP)

31530 CHARGE EXCHANGE IN π^-n INTERACTIONS AT 40 GeV/c. Angelov, N.; Anyola, L.; Ivanovskaya, I. A.; Kladnitskaya, E. N.; Mel'nikova, N. N.; Mihul, A.; Fadeev, N. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 6, 1162-1167(Dec 1975). (In Russian).

Multiple production of particles in π^-n interactions is studied from the point of view of charge exchange between an initial particle and a group of secondary particles moving into the forward hemisphere in the c.m.s. It is shown that the mean value $\langle\Delta Q\rangle$ of the exchange charge is not zero and equals 0.23 ± 0.03. The most essential contribution to ΔQ distribution is from ΔQ=0 and ΔQ= 1 events (≈75%), which fact gives an evidence for the dominance of multiperipheral processes. The $(\Delta Q - \langle\Delta Q\rangle)$ distribution coincides with the corresponding distributions for π^-p, K^-p and pp interactions in 10–205 GeV/c momentum range. (auth)

31531 CURRENT QUARKS, CONSTITUENT QUARKS AND THE REACTIONS $K^-p \to \pi^0\Lambda$. Buccella, F. (Univ., Rome); Savoy, C. A.; Sorba, P. Nuovo Cim., 31A: No. 2, 277-293(21 Jan 1976).

The transformation between current and constituent quarks is considered in view of the checking of the contributions, through PCAC, of the Σ^*-resonances to the reactions $K^-p \to \pi^0\Lambda^*$ (with negative parity) and the decays $\Sigma^* \to K^-p$ and $\Sigma^* \to \pi^0\Lambda^*$. Both the Σ^*'s and Λ^*'s under consideration are classified in the 70, L = 1 representation. In the model only one parameter is left, contrary to what happens in pure group-theoretical approach. The predictions are almost independent of its value and in good agreement with experiment. (auth)

31532 ANALYSIS OF THE N*(1700)-RESONANCE. di Salvo, E. (Univ., Geneva). Nuovo Cim., 31A: No. 4, 653-668 (21 Feb 1976).

Some model-independent tests are presented to analyze the production mechanism and the decay of the N*(1700). Some of them are of general interest. (auth)

31533 DIFFRACTIVE PRODUCTION OF RESONANCES AND THE DECK MECHANISM. Bowler, M. G. (Univ. of Oxford). pp 101-110 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

The singular properties of the amplitude $B\,e^{i\delta}\cos\delta + A/k \sin\delta\, e^{i\delta}$ where δ is a two-body phase shift and B is a diffractive production amplitude of the Drell-Hiida-Deck kind, are discussed. It is shown that it is not correct, as generally believed, that in production processes a two particle channel picks up a dominant phase factor $e^{i\delta}$ automatically and that severe resonance distortion may occur and may be accompanied by phase variation widely different from $e^{i\delta}$. All that is required is a background amplitude not completely dominated by direct resonance production. A model is presented which deals successfully with ρ distortion in photoproduction and seems to be capable of explaining observations on diffractive production of N* systems that had previously received no explanation. The data on A_1 and Q (where there is no independent evidence for resonances) fit nicely into this framework. (UK)

31534 AMPLITUDE ANALYSIS FOR THE REACTION pi^+p yields $pi^+pi^-pi^0$ DELTA^{++} AT 7 GeV/c. Wagner, F.; Tabak, M.; Chew, D. M. (Lawrence Berkeley Lab., CA). pp 111-116 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (Eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

An amplitude analysis for the reaction pi^+p yields $pi^+pi^-pi^0$ DELTA^{++} at 7 GeV/c was performed using the isobar model for the 3 pi system. The 3 pi-mass covers the range from 0.82 to 1.90 GeV. Strong A_2 production is observed. The spin parity of the omega* (1700) is determined to be 3^-. No significant A_1 production can be seen. (auth)

31535 SOME REMARKS ON ANALYSES OF MULTI-MESON SYSTEMS. Chaloupka, V. (CERN, Geneva). pp 121-124 of Three Particle Phase Shift Analysis and Meson Resonance Production. Dainton, J. B.; Hey, A. J. G. (eds.). Daresbury, England; Daresbury Laboratory (1975).

From proceedings of the Daresbury study weekend; Warrington, UK (1 Feb 1975). See DL/R-34; CONF-750237-.

A brief review of some of the assumptions and limitations of the presently used analyses of multi-meson systems is given. The relations between the density matrix and amplitude approaches for analysis of produced multi-meson systems, when the baryon polarizations are not measured, are discussed. It is concluded that an analysis combining the rank approach and the density matrix approach in successive steps would seem very useful. (UK)

31536 ANALYSIS OF BACKWARD πN SCATTERING USING A MULTIPLE-SCATTERING MODEL. Musette, M. (Univ., Brussels). Nuovo Cim., A; 31A: No. 3, 529-547(1 Feb 1975).

A multiple-scattering model is used to analyze the experimental data of the backward πN scattering at 6 GeV/c. The elementary backward collisions π^+p and π^-p are described by a Regge-pole model with the Δ_δ and N_α linear trajectories while the multiple-scattering correction terms are convolution products of the Regge-pole terms and the amplitudes corresponding to the forward scattering. The s helicity amplitudes Δ and N respectively associated to isospin $\frac{3}{2}$ and $\frac{1}{2}$ in the u-channel are deduced and compared with the results of other models. (auth)

31537 POLARIZATION CALCULATIONS IN A BOX-DIAGRAM MODEL. Singh, C.P. (Department of Physics, Banaras Hindu University, Varanasi 221005, India). Phys. Rev. D 13: No. 3, 767-770 (1 Feb 1976).

A box-diagram model is presented in which we assume that the exotic exchange reaction $\pi^-p \to \Sigma^-K^+$ occurs as a result of multiple nonexotic exchanges, e.g., $\pi^-p \to \rho^0 n \to \Sigma^-K^+$, and each step of this process is evaluated under t-channel single-pole approximations. The imaginary part thus obtained when multiplied by the real contributions of one-particle-exchange diagrams accounts for the main features of the polarization data of Σ^-. (auth)

31538 REGGE EXCHANGE AND ABSORPTION IN THE INCLUSIVE REACTION $\pi^-p \to \pi^0X$. Pumplin, J. (Department of Physics, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. D 13: No. 5, 1261-1265 (1 Mar 1976).

We predict the cross section for the inclusive process $\pi^- p \to \pi^0$ + anything in the region $X_{\pi^0} \gtrsim 0.7$, using a triple-Regge model with absorption corrections. Absorption is calculated by a generalization of Regge-cut theory in two-body reactions, and is consistent with data on $\pi^- p \to \pi^0 n$. We conclude that measurements of $\pi^- p \to \pi^0 X$ at laboratory energies > 100 GeV will yield important new information on the strength of absorptive effects in strong interactions. In particular, we predict that the effective ρ trajectory in $\pi^- p \to \pi^0 X$ will lie higher than in $\pi^- p \to \pi^0 n$ by ~ 0.3, for $-t \gtrsim 0.8$ GeV^2 and $x \sim 1$. The cross section will show no dip structure at $-t \simeq 0.6$ GeV^2 or elsewhere, contrary to the predictions of models with nonsense-wrong signature zeros. (auth)

31539 POSSIBLE AMBIGUITIES IN πN PHASE-SHIFT ANALYSIS. Brunet, R.C. (Départment de Mathématique, Université de Montréal, Montréal, Québec, Canada); Gauthier, L.; Winternitz, P. Phys. Rev. D 13: No. 5, 1390-1404 (1 Mar 1976).

We discuss possible ambiguities in the reconstruction of πN scattering amplitudes from experimental data and the elastic unitarity condition below the threshold of inelastic processes. We restrict ourselves to partial waves with $l = 0$ and 1 and show that certain twofold ambiguities can occur if only two experimental quantities are measured (the cross section plus polarization or one of the polarization parameters). We also show that these ambiguities can be removed by a further measurement, unless the polarization happens to be zero or the experiment is performed at an unfortunately chosen angle, for which both sets of amplitudes predict the same value for the corresponding experimental quantity. (auth)

31540 DIFFRACTIVE SLOPES OF ψp, ϕp, AND ρp SCATTERING. Jones, S.T. (Department of Physics and Astronomy, The University of Alabama, University, Alabama 35486). Phys. Rev. D 13: No. 5, 1496-1498 (1 Mar 1976).

Using a strong-coupling multiperipheral model, we calculate diffractive component of the slope of the elastic differential cross sections for vector meson-proton scattering. The relative flatness of these slopes is explained by the differences in the pseudoscalar-meson masses. Good qualitative agreement with experiment is obtained. (auth)

31541 GHOST CUTS OF THE NUCLEON PROPAGATOR. Fishman, S.; Gersten, A. (Department of Physics, Ben Gurion University of the Negev, Beer-Sheva, Israel). Phys. Rev. D 13: No. 6, 1769-1777 (15 Mar 1976).

We demonstrate in our work, on the special example of dressing the nucleon propagator, that if ghost poles exist, they lead to ghost cuts, and the ghost cuts generate new ghost cuts. The geometry of the location of these cuts in the complex s plane is fully discussed and analyzed. We found a simple exact parametric representation of the nth ghost cut: $s = s_g/(1-p) + (n\mu)^2/p$, where p is a real parameter $0 \leqslant p \leqslant 1$, s_g is the location of the ghost pole, and μ is the pion mass. When the location of the ghost pole approaches the nucleon pole, the ghost cuts approach the unitarity cut. The renormalization procedure is adopted to the case of a ghost pole appearing on the real axis of s. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 31677.

31542 DESCRIPTION OF ELASTIC SCATTERING IN THE U-MATRIX METHOD. Edneral, V.F.; Troshin, S.M.; Tyurin, N.E.; Khrustalev, O.A. (Institute of High Energy Physics). JETP Lett. 22: No. 6, 163-164 (20 Sept 1975).

An analysis is presented of elastic pp scattering on the basis of a generalized matrix of the reactions (the U matrix). Good agreement is obtained with the experimental data on $\sigma_{tot}(pp)$ starting with 30 GeV, and for $d\sigma/dt$ (pp) for four ISR energies. (auth)

31543 OFF-SHELL T-MATRIX ELEMENTS FOR SINGULAR NUCLEON–NUCLEON INTERACTIONS. Widmann, T.; Gall, H.; Weigel, M. K. (Univ., Munich). Lett. Nuovo Cim.; 15: No. 10, 351-355(6 Mar 1976).

For the study of T matrix elements for singular nucleon–nucleon interactions, a method is used designed for nucleon–nucleon potentials with hard-core repulsion. Explicit results are given for the Hamada–Johnson potential, which is treated up to L = 2. The procedure is divided into three parts: first, one transforms the Lippmann–Schwinger equation into an equivalent equation for the wave matrix since for local potentials it is easier to solve a Schroedinger-like equation using a mixed coordinate momentum representation. (JFP)

31544 ISOBAR ADMIXTURES IN A DEUTERON. Markushin, V. E. (Moscow Physics-Engineering Inst.). Yad. Fiz.; 22: No. 6, 1079-1084(Dec 1975). (In Russian).

The Δ isobar admixture in a deuteron is studied. Theoretical predictions of the value of the Δ admixture are obtained as well as the space and momentum distributions of various isobar states. (auth)

31545 DIFFRACTIVE DISSOCIATION OF A PROTON TO SMALL MASSES AND PRODUCTION OF NUCLEON ISOBARS AT SEVERAL HUNDRED GeV ENERGIES. Konovalenko, A. I.; Kuchin, I. A.; Usik, P. A. (Inst. of High Energy Physics, Alma-Ata, USSR). Yad. Fiz.; 22: No. 6, 1248-1252(Dec 1975). (In Russian).

The one-pomeron-exchange model including the purely resonant proton excitation is used to explain the data on the diffractive dissociation of a proton in pp interactions at several hundred GeV energy. It is shown, in particular, that the diffractional peak at $M_x \lesssim 2$ GeV in the missing mass spectrum of the $p + p \to p + X$ reaction can be fitted by a superposition of known nucleon isobars and their recurrences. (auth)

31546 DECK MODEL APPLIED TO THREE PI PRODUCTION ON NUCLEI. Cutler, R. T. Urbana, IL; Univ. of Illinois (1975). 112p. University Microfilms Order No. 76-6740.

Thesis (Ph. D.).

A Reggeized Deck model is applied directly to the reactions $\pi^- C \to \pi^+\pi^-\pi^- C^*_{4,44}$ and $\pi^- A \to \pi^+\pi^-\pi^- A$, where A is a nucleus, using a Monte Carlo approach where events are generated from the model and then analyzed as if they were experimental data. Comparisons with data are made, and a partial wave analysis of the reaction $\pi C \to 3\pi C^*$ is performed. A Glauber theory is developed for the reaction $\pi^- A \to \pi^+\pi^-\pi^- A$, where A is a nucleus, using a Reggeized Deck amplitude for 3π production on a nucleon. A simple absorption amplitude for the 3π system is used in which the pions are assumed not to interact. The resulting amplitude is compared to experiment using a Monte Carlo approach. An alternative absorption scheme is discussed, and a multi-impact parameter model proposed. The multi-impact parameter model is found to result in cross sections practically identical to computationally simpler models. The reaction $\pi^- C \to \pi^+\pi^-\pi^- C^*_{4,44}$ is also calculated using an effective one particle excitation parameterization, and the results compared to experimental data at 6 GeV/c. (Diss. Abstr. Int., B)

31547 PREDICTIONS OF THE SPIN PARAMETER D IN THE INCLUSIVE PROCESS pp → pX. Hidaka, K. (Tokyo Univ.). Lett. Nuovo Cim.; 15: No. 6, 195-199(7 Feb 1976).

The use of the data on the D parameter in the process $pp\downarrow \to p\downarrow X$ is discussed to test the validity of the estimation of the π exchange made previously according to which the π exchange takes a significant part in the invariant cross section. An attempt is made to make a prediction of the D parameter in the normal Regge region (including the triple-Regge region) in the framework of the Mueller–Regge model. In this prediction one assumes that the π exchange dominates the unnatural-parity exchange, and uses the estimation of the pion contribution calculated previously and the existing data on the cross section. (JFP)

31548 GLAUBER MODEL CALCULATION OF THE $\sigma(\pi d \to \pi\Delta\Delta)$ CROSS SECTION FROM THE POINT OF VIEW OF A POSSIBLE $\Delta\Delta$ ADMIXTURE TO THE GROUND STATE DEUTERON WAVE FUNCTION. Jacholkowski, A. (Univ., Warsaw). Acta Phys. Pol., Ser. B7: No. 3, 191-195(Mar 1976).

The reaction $\pi d \to \pi\Delta\Delta$ is analyzed from the point of view of a $\Delta\Delta$ admixture to the deuteron ground state wave function. A simplified Glauber model approach is used to obtain $\sigma(\pi d \to \pi\Delta\Delta) = 0.3\,\mu$b. This value was calculated for 21-GeV/c incident pions but it is not sensitive to the primary pion energy. (auth)

31549 MULTIPLICITY OF SECONDARY PARTICLES IN INCLUSIVE HADRON–NUCLEUS REACTIONS. Grishin, V. G.; Eliseev, S. M.; Inogamova, T. Ya. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 23: No. 1, 191-197(Jan 1976). (In Russian)

Calculations of average multiplicities of secondary particles produced in high energy hadron-nucleus interactions are presented. It is shown that the sample cascade model does not explain the available experimental data even at E ≥ 30 GeV. Two possible improvements of the model are considered: introduction of many-particle interactions and an account of the effect of decreasing interaction cross sections for leading particles inside the nucleus. These modifications enable one to describe the experimental data. (auth)

31550 WEAK NEUTRAL PROTON CURRENT IN INCLUSIVE pp SCATTERING. Shmatikov, M. Zh. (Inst. of Atomic Energy, Moscow). Yad. Fiz.; 23: No. 1, 136-138(Jan 1976). (In Russian)

Dependence of the proton scattering cross section on the target polarization due to the weak neutral currents is estimated for the process $p + p \to p + X$. (auth)

31551 OBSERVATION OF CHARGE ASYMMETRY IN THE REACTION $p + p \to p + p + X^0$ AND $p + p \to p + X^+$ AT 28.5 GeV/c.

Laasanen, A. T.; Ezell, C.; Gutay, L. J.; Lazarus, E.; Schreiner, W. N.; Schuebelin, P.; Turkot, F. (Purdue Univ., West Lafayette, IN). Lett. Nuovo Cim.; 15: No. 8, 274-278(21 Feb 1976).

A rapidity and transverse momentum dependent charge asymmetry was observed in proton-induced meson production at 28.5 GeV/c. It is suggested that the observation supports one of the basic assumptions of the constituent interchange model in agreement with the interpretation of a similar result in π^-p interactions. The π^+ to π^- ratio and effective-mass distributions are shown. (JFP)

31552 INCREASE OF THE MULTIPLICITY AS A FUNCTION OF TRANSVERSE MOMENTUM IN THE UNCORRELATED JET MODEL AT 28.5 GeV/c IN pp COLLISIONS. Sohlo, S. (Univ., Bielefeld, Ger.). Lett. Nuovo Cim.; 15: No. 8, 279-283(21 Feb 1976).

A discussion is given as to what features of the data on the associated charged multiplicity in pp interactions require the introduction of a specific dynamical model. (JFP)

31553 ORIGIN OF "DIRECT" LEPTONS. Dologshein, B.A.; Nikitin, Yu.P.; Rozhnov, G.V. (Moscow Engineering Physics Institute). JETP Lett. 22: No. 7, 180-182 (5 Oct 1975).

Experiments are analyzed on processes of the type $p+N \rightarrow l^{\pm}+X$, in which "direct" leptons with large transverse momenta are detected. It is shown that an appreciable contribution to such processes is made by the decays $\psi(3105) \rightarrow l^+ + l^-$. (auth)

31554 POLARIZATION IN INCLUSIVE PROCESSES. Turbiner, A.V. (Institute of Theoretical and Experimental Physics). JETP Lett. 22: No. 7, 182-184 (5 Oct 1975).

Formulas are derived within the framework of the reggeized one-pion exchange for the polarization of an investigated particle in inclusive processes in the fragmentation region. The reaction $pp \rightarrow \Lambda X$ is investigated at high energies and a nonzero polarization of the Λ hyperons is predicted. (auth)

31555 INCLUSIVE PRODUCTION OF Λ^0 HYPERONS ON CARBON AND XENON NUCLEI IN A REGION KINEMATICALLY FORBIDDEN FOR PRODUCTION ON FREE NUCLEONS. Vorob'ev, I.I.; Leksin, G.A.; Novikov, L.S.; Smirnitskiĭ, A.V. (Institute of Theoretical and Experimental Physics). JETP Lett. 22: No. 7, 184-185 (5 Oct 1975).

We measured the cross section for the production of Λ^0 hyperons on nuclei in a region kinematically forbidden for the production on a free nucleon. The distribution of the events in momentum-angle coordinates is presented. The function $f = (E/p^2)(d\sigma/dpd\Omega)$ is constructed for three angle ranges. The result of polarization measurement is presented. (auth)

31556 REGGE TRAJECTORY OF THE $\psi(J)$ PARTICLES AND *pp* ELASTIC SCATTERING AT LARGE ANGLES. Arik, M. (Brookhaven National Laboratory, Upton, New York 11973); Coon, D.D.; Yu, S. Phys. Rev. D 13: No. 3, 571-573 (1 Feb 1976).

It is shown that the proton–proton elastic scattering data at large angles can be described by a trajectory with the same shape as the ψ (J) trajectory. (auth)

31557 ON THE ENERGY DEPENDENCE OF CHARGED-PARTICLE MULTIPLICITY. Šoln, J. (Harry Diamond Laboratories, Electromagnetic Effects Laboratory, Adelphi, Maryland 20783). Phys. Rev. D 13: No. 3, 591-602 (1 Feb 1976).

Within the framework of the charge-conserving hadronic bremsstrahlung model and using the lower-regime-of-high-energy collisions approximation, we derive a new expression for the integral mean multiplicities of produced charged particles. Although in *pp* collisions the lower-energy regime extends to about $s \simeq 60$ GeV^2 [s = the c.m. (center of mass) energy squared], the expressions for the integral mean charged-particle multiplicities describe the trend of the experimental data surprisingly well through the CERN-ISR (intersecting-storage-ring) energies ($s \approx 2000$ GeV^2). This, according to our formalism, is an indication that mean multiplicities are rather smooth functions of t (the negative square of the c.m. momentum transfer of protons) for all s. (auth)

31558 π^+ AND π^- MOMENTUM DISTRIBUTION NORMAL TO THE PRODUCTION PLANE IN THE REACTION $pp \rightarrow pp$ + MESONS. Ezell, C.; Laasanen, A.T.; Gutay, L.J. (Physics Department, Purdue University, West Lafayette, Indiana 47907); Schreiner, W.N.; Schübelin, P.; Turkot, F. Phys. Rev. D 13: No. 5, 1150-1152 (1 Mar 1976).

The π^+ and π^- momentum distribution normal to the production plane is studied. The dispersion of the momentum distribution normal to the production plane is independent of the transverse momenta of the trigger protons. (auth)

Particle Invariance Principles and Symmetries

Refer also to abstract 32038.

General

Refer also to abstracts 31394 and 32086.

31559 CP VIOLATION IN THE DECAY OF CHARMED MESONS. Rachman, N. (Univ. of Tel Aviv, Israel). Lett. Nuovo Cim.; 15: No. 10, 356-358(6 Mar 1976).

A previously proposed model with three charmed quarks is considered with the strong-interaction quantum number charm extended in a given way. The (K_L,K_S) system is taken as a guideline for the study of the CP-violating effect. (JFP)

31560 NEW QUARKS AND BARYON SPECTROSCOPY. Bogolyubov, P.N.; Krasnikov, N.V.; Kuz'min, V.A.; Matveev, V.A.; Chetyrkin, K.G. (Nuclear Research Institute, USSR Academy of Sciences). JETP Lett. 22: No. 5, 146-149 (5 Sept 1975).

The masses of new baryons in the multiplets of the *SU* (5) group are calculated. (auth)

31561 CRITICAL LOOK AT f_K/f_π IN THE $(3,\bar{3}) + (\bar{3},3)$ MODEL. Chan, L.; Haymaker, R.W. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Phys. Rev. D 13: No. 5, 1302-1308 (1 Mar 1976).

We discuss the prediction of f_K/f_π that follows from chiral symmetry in the $(3,\bar{3}) + (\bar{3},3)$ model from a general point of view. We present the results of the one-loop corrections in the renormalizable SU_3 σ model. These results are compared with a number of other approaches, including chiral perturbation theory. All approaches discussed here have uncertainties in f_K/f_π at least as large as, often much larger than, the experimental error in f_K/f_π. This is traced to the appearance of the mass difference $m^2_\eta - m^2_K$ which is uncertain to $\pm$ 4% owing to isospin splitting. (auth)

31562 PHENOMENOLOGY OF THE CURRENT-CONSTITUENT QUARK TRANSFORMATION FOR THE VECTOR-GLUON MODEL. Fuchs, N.H. (Physics Department, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 13: No. 5, 1309-1315 (1 Mar 1976).

The transformation relating the expansion of hadronic states in the current- and constituent-quark bases is studied in the context of the vector-gluon model. A phenomenological approach is used to estimate the effects of interaction on the algebraic structure of matrix elements describing pionic, electromagnetic, and weak transitions of hadrons. Contributions of terms with exotic transformation properties are found to be negligible in most instances, but are important for higher moments of deep-inelastic structure functions. The magnitude of such terms is related to that of the mass splitting of SU(6) multiplets. (auth)

31563 STUDY OF THE ALLOWED DOMAINS FOR THE PARAMETERS OF $(3,3^*) \oplus (3^*,3) \oplus (8,8)$ CHIRAL SYMMETRY BREAKING. Geddes, H.B.; Graham, R.H. (Department of Physics, University of Toronto, Toronto, Ontario, Canada, M5S 1A7). Phys. Rev. D 13: No. 5, 1437-1448 (1 Mar 1976).

The allowed domains of the parameters describing a chiral-symmetry-breaking Hamiltonian belonging to the $(3,3^*) \oplus (3^*,3) \oplus (8,8)$ representations of SU(3) $\times$ SU(3) are investigated. In addition to constraints on these parameters arising from spectral-function positivity we employ conditions corresponding to bounds on the ratio f_K/f_π of kaon- to pion-decay constants and on the $\pi\pi$ S-wave $I = 0$ and 2 scattering lengths. It is found that these constraints are extremely effective in reducing the size of the allowed domains. Particular attention is focused on the Gell-Mann–Oakes–Renner, Okubo, and Sirlin-Weinstein forms of symmetry breaking, which are special cases of the general $(3,3^*) \oplus (3^*,3) \oplus (8,8)$ scheme. (auth)

31564 COMMENTS ON CHIRAL-SYMMETRY SUM RULES WITHOUT AN A_1. Chen, M.; Kane, G.L.; Krisch, J. (Physics Department, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 13: No. 5, 1499-1501 (1 Mar 1976).

Recent experimental evidence implies that there is no A_1 resonance. We examine some consequences of this for the interpretation of chiral symmetry in terms of sum rules and their contribution from low-mass vector or axial-vector states. (auth)

31565 EXTREME EXAMPLE OF REARRANGEMENT OF SPONTANEOUSLY BROKEN SYMMETRY. Matsumoto, H.; Papastamatiou, N.J.; Umezawa, H. (Department of Physics, University of Wisconsin—Milwaukee, Milwaukee, Wisconson 53201). Phys. Rev. D 13: No. 4, 1054-1063 (15 Feb 1976).

A model of spontaneously broken SU(2) symmetry is presented in which the generators in-field (phenomenological) transformations do not form a closed algebra. The consequences of such incomplete observational symmetries are described. Of particular interest is the emergence of current-algebra-type relations, corresponding to a partially conserved isospin current, although the isospin current is strictly conserved in this model. This suggests a possible reinterpretation of current-algebra results. (auth)

31566 E_7 AS A UNIVERSAL GAUGE GROUP. Gürsey, F. (Physics Department, Yale University, New Haven, Connecticut 06520); Sikivie, P. Phys. Rev. Lett. 36: No. 14, 775-778 (5 Apr 1976).

The exceptional group E_7 is proposed as a spontaneously broken gauge group underlying a unified field theory of the strong, electromagnetic, and weak interactions. The resulting model, which has only one gauge coupling constant and only one multiplet of elementary fermions, is shown to be compatible with the phenomenology of weak and electromagnetic interactions, including e^+e^- annihilation and high-energy neutrino scattering. (auth)

31567 "COLOR" AS A CLASSIFICATION SYMMETRY AND QUARK CHARGES. Mohapatra, R.N. (Department of Physics, The City College of the City University of New York, New York, New York 10031); Pati, J.C.; Salam, A. Phys. Rev. D 13: No. 6, 1733-1743 (15 Mar 1976).

We discuss the problem of defining a residual global symmetry for classification purposes in the context of a spontaneously broken gauge theory of strong, weak, and electromagnetic interactions, where strong interactions are associated with a local color SU(3)′ group. We show that a weakly broken $SU(3)_c$ [different from but related to SU(3)′] can always be realized as a *good* classification symmetry for a class of models with integer-charge quarks and massive gluons. For fractionally charged quark models, the symmetry $SU(3)_c$ is exact even for massive gluons, only *if* the full theory contains an Abelian U(1) symmetry associated with electric charge. If there is no such U(1) symmetry in the theory, and we wish to preserve a three-color classification symmetry in the fractionally charged quark model, then the gluons must be left massless. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 31470 and 31471.

31568 PROBLEMS WITH WEAK PARITY-VIOLATING POTENTIALS. Tadic, D. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). Acta Phys. Slovaca; 24: No. 4, 09-223(1974).

From triangle meeting on weak interactions; Smolenice, Czechoslovakia (4 Jun 1973).

Problems connected with parity-violating potentials in weak Hamiltonians are discussed and some general statements including recently obtained results are presented. (auth)

31569 MEASUREMENT OF THE *CP*-NONCONSERVING DECAY, $K^0_L \to 2\pi^0$. Rey, C.A. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556); Cence, R.J.; Jones, B.D.; Parker, S.I.; Peterson, V.Z.; Stenger, V.J.; Kenney, R.W.; Linscott, I.R.; Oliver, W.P. Phys. Rev. D 13: No. 5, 1161-1186 (1 Mar 1976).

The rate of the *CP*-nonconserving decay $K^0_L \to 2\pi^0$ has been measured using a monoenergetic K beam and a nearly-4π-solid-angle detector system employing lead-plate spark chambers and shower counters. Final results based on a detailed analysis of the complete data set are given. The branching ratio of $K^0_L \to 2\pi^0$ is determined relative to three different normalizations, $K^0_L \to 3\pi^0$, $K^0_L \to$ all charged decay modes, and $K^0_L \to K^0_S$ using a beryllium regenerator. From the $K^0_L \to 2\pi^0$ rate we find the *CP*-nonconserving parameter $|\eta_{00}|^2 = [14.1 \pm 1.9\ (\text{stat}) \pm 1.5\ (\text{syst})] \times 10^{-6}$. (auth)

31570 NONLEPTONIC DECAYS OF HYPERONS AND Ω^- IN SU(4). Khanna, M.P. (Physics Department, Panjab University, Chandigarh-160014, India). Phys. Rev. D 13: No. 5, 1266-1267 (1 Mar 1976).

The nonleptonic decays of octet baryons and Ω^- are studied in the framework of current algebra assuming SU(4) symmetry and $\underline{20}'$ dominance of the weak Hamiltonian. For the parity-conserving transitions of hyperon decays, the predictions are in good agreement with experiment. But the results for parity-violating hyperon decays and Ω^- decays are not satisfactory. (auth)

31571 $\psi' \to \psi\eta$: SU(3) ALLOWED OR SU(3) SYMMETRY BREAKING? Machacek, M.; Tomozawa, Y. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 13: No. 5, 1449-1453 (1 Mar 1976).

We investigate the SU(3) nature of the $\psi' \to \psi\eta$ decay by comparing its effective coupling constant with that for the SU(3) -allowed $\omega \to \rho\pi$ coupling using the $\omega \to \pi\gamma$ decay width and ρ dominance of the photon. The result is completely consistent with an SU(3) - symmetry-breaking interpretation of the $\psi' \to \psi\eta$ decay. (auth)

31572 RADIATIVE DECAYS OF THE VECTOR MESONS AND THE MESON MIXING ANGLES. Boal, D.H. (Theoretical Physics Institute, Department of Physics, University of Alberta, Edmonton, Alberta, Canada T6G 2E1); Graham, R.H.; Moffat, J.W. Phys. Rev. Lett. 36: No. 13, 714-716 (29 Mar 1976).

A general SU(3) analysis of vector meson and pseudoscalar meson radiative decays is carried out. Two solutions are obtained corresponding either to an inverse-square mass formula or to a linear mass formula for vector mesons that lead to reasonable agreement with most of the radiative decays. (auth)

31573 MEASUREMENTS OF THE LIGHT FLASH PRODUCED BY HIGH VELOCITY PARTICLE IMPACT. Eichhorn, G. (Max-Planck-Institut fuer Kerphysik, Heidelburg). Planet. Space Sci.; 23: No. 11, 1519-1525(Nov 1975).

The impact light flash produced by electrostatically accelerated iron particles with diameter ranging from 5 to 0.05 μm and velocities lying between 1 km/sec and 30 km/sec has been investigated by means of photomultipliers. As target materials mainly gold and tungsten were used. Using the spectral distribution of the light intensity, measured by means of calibrated photomultipliers, the total amount of light energy emitted in the visible range could be calculated. As a result it was found that for $v = 4$ km/sec and $m = 10^{-11}$ g about 3×10^{-4} of the kinetic energy of the particle was converted into light energy. The variation of the impact flash intensity with the target material and the measured spectral distribution allowed the temperature of the crater after the impact to be estimated as between 2000 and 3000 k. (auth)

Applications (Strong)

Refer also to abstract 31681.

31574 SU(3) SYMMETRY AND HADRON MASS SPECTRUM. Savel'ev, M. V.; Khrushchev, V. V. (Inst. of High Energy Physics, Serpukhov, USSR). Yad. Fiz.; 22: No. 6, 1253-1254(Dec 1975). (In Russian).

The quadratic (common in structure) mass formula, containing a small number of fitting parameters was proposed, under assumption on SU(3, 1) dynamical symmetry. The fitting parameters take the equal values for particles with the same spin-parity. The mass spectrum, obtained on the basis of this formula is in good agreement with the experimental data. (auth)

31575 SOME REMARKS ON THE $U_A(1)$ PROBLEM IN GAUGE THEORIES OF THE STRONG INTERACTION. Pagels, H.R. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 13: No. 2, 343-345 (15 Jan 1976).

Previously proposed solutions to the U_A (1) problem, or ninth axial-vector current problem, are reviewed and a new solution proposed. We point out that in the presence of magnetic gauge charges the anomalous term $F^{\alpha\beta} {}^*F^{\alpha\beta}$ is not a total divergence. This implies that the $U_A(1)$ symmetry is explicitly broken. (auth)

31576 EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT SU(3) IS CONTAINED IN 0(3). Moshinsky, M.; Patera, J.; Sharp, R. T.; Winternitz, P. (Univ. of Montreal). Ann. Phys. (N.Y.); 95: No. 1, 139-169(Nov 1975).

From a uniform viewpoint one discusses three old bases for representations of SU(3) reduced according to 0(3), the Bargmann-Moshinsky, Elliott and stretched bases, together with one new one, the antistretched basis. Expansions are obtained for the various bases in terms of each other and in terms of the Gel'fand basis of the SU(3) is contained in SU(2) x U(1) scheme. Overlaps are given between states of the same or different bases. Orthogonal bases defined by diagonalization of a suitable Hermitian operator are discussed and related to the analytic bases. (auth)

31577 QUARK ASPECT OF PARTONS. Kurdgelaidze, D. F. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 105-109(1975). (In Russian)

It is shown that a nonet of baryons, as well as a nonet of mesons, can be represented as a set of three different triplets. The values Q, Y and $2T_3$ of these triplets coincide with the corresponding values for three, whole-number triplets of the quarks of Nambu. In this regard it is proposed that the quarks of Nambu be described not by $SU(3) \otimes SU(3)'$ as ordinarily, but by $SU(3) \otimes SU(3)' \otimes SU(3)''$. Then these quarks, analogous to baryons, will be composites made up of other quarks. The latter will also be made up of other quarks, and thus a whole hierarchy of quarks is obtained. It is also proposed that the assembly of all these states be identified with partons. (tr-auth)

Scattering Theory

Refer also to abstracts 31500, 31501, 32050–32054, 32087, and 32091–32093.

31578 (INIS-mf-1899) INTRODUCTION TO THE S MATRIX CONCEPT. Leite Lopez, J. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Centre de Recherches Nucleaires). 1974. 25p. (In French). INIS.

The theory of collision problems is posed in Heisenberg's representation. S-matrix is defined as the probable amplitude for the

particles prepared in the past infinity as free particles in a given state to emerge in the future infinity, as free particles in a given state. The form of the S-matrix in nonrelativistic theory and in the Schroedinger representation, the observables and the S-matrix relativistic invariance, the l-matrix, the transition probability and the cross section are studied.

31579 (JINR-R-2-8052) RESCATTERING OF REGGEONS IN φ-4-THEORY. Gershenkevich, M. V.; Efremov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 13p. (In Russian). INIS.

16 refs.; 2 figs.; submitted to the journal Theoretical and Mathematical Physics.

31580 HIGH ENERGY SCATTERING AMPLITUDE FOR INVERSE POWER SINGULAR POTENTIALS. Gribov, V. A. (Moscow State Univ.). Teor. Mat. Fiz.; 26: No. 1, 48-60(Jan 1976). (In Russian).

Well known approximate expressions for phase shifts $\delta(\lambda,k)$ of the scattering on the potential $V(r)=g^2r^{-n}$ $(g > 0, n > 2)$ at high energies are modified by means of adding a certain polynomial in λ to the small λ approximation and subsequent matching with the large λ approximation. Approximate expressions for scattering amplitude $f(\theta,k)$ and the differential cross section $d\sigma/d\theta$ are derived for different values of θ as $k \to \infty$. The inverse power potentials are shown to be weakly singular in the sense that their singular core determining partial waves with small λ and large angle scattering does not affect the total cross section as $k \to \infty$. (auth)

31581 NEW POSSIBILITIES FOR ANALYTICAL TESTS. Vernov, Yu. S. (Inst. of Nuclear Research, Moscow); Dumbrais, O. V.; Dumbrais, T. Yu.; Mnatskanova, M. N. Teor. Mat. Fiz.; 26: No. 1, 137-140(Jan 1976). (In Russian).

It is shown that if the dispersion relations for the scattering amplitude are valid, then the dispersion relations for the logarithm of the amplitude are valid too, without any additional assumptions. A new method of the test of analyticity is suggested. (auth)

31582 ACCOUNT OF THE MULTISCATTERING IN THE RESONANCE APPROXIMATION. Senyushkin, V. B. Vestn. Leningr. Univ., Fiz., Khim.; No. 3, 13-16(Aug 1975). (In Russian).

The resonance approximation and method of Padé-approximants are used for the calculation of multiscattering corrections. (auth)

31583 LOW-ENERGY SCATTERING BY A NONSYMMETRICAL POTENTIAL. Nonresonance Case. Andreeva, T. G.; Rudakov, V. S. Vestn. Leningr. Univ., Fiz., Khim.; No. 3, 37-40(Aug 1975). (In Russian)

The stationary quantum mechanics problem of the scattering by a nonsymmetrical potential is considered. The approximate determination method of eigenfunctions and eigenphases of the S-matrix is suggested. This method can be used for describing the low energy nonresonance scattering. (auth)

31584 INTERPRETATION OF KATO'S INVARIANCE PRINCIPLE IN SCATTERING THEORY. Dollard, J. D. (Univ. of Texas, Austin). J. Math. Phys. (N.Y.); 17: No. 1, 46-51(Jan 1976).

A simple proof is given that Kato's invariance principle holds for a class of generalized piecewise linear (GPL) functions, under the sole assumption of existence of the Moeller wave operators. The invariance principle for GPL functions is viewed as an expression of freedom to change the scale of time and shift the zero point of energy. It is remarked that whenever scattering theory can be done, it can be done with bounded Hamiltonians. The motion of a particle is studied when its Hamiltonian is replaced by a GPL function of this Hamiltonian. (auth)

31585 CAN DISPERSION RELATIONS PREDICT SOMETHING ABOUT HIGH ENERGY BEHAVIOR OF SCATTERING AMPLITUDES. Pisut, J. (Comenius Univ., Bratislava). Czech. J. Phys.; B26: No. 1, vp(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

It is argued that dispersion relations do have some, though limited, predictive power provided that some qualitative features of scattering amplitudes are known or assumed. A method is described which can be used in practical calculations. The method is essentially a test of the analyticity of the scattering amplitude. The amplitude is given at lower energies by the experimental data and at asymptotic energies it is represented by an ansatz containing some free parameters. (auth)

31586 COLLISION OPERATOR AND INVARIANT FOR QUANTUM SYSTEMS WITH DISCRETE SPECTRUM. Courbage, M. (Univ., Brussels). Bull. Cl. Sci., Acad. R. Belg.; 61: No. 5, 715-733(1975). (In French).

The analyticity properties of the collision operator at the origin are studied rigorously in relation to the properties of the invariants called regular. It is shown, for a large class of quantum systems having a discrete spectrum, that the nondegeneracy of the free Hamiltonian spectrum is a sufficient condition for the analytic part at the origin of the collision operator is identically null. On the contrary the degeneracy of the spectrum of H_0 is a necessary condition and one of the sufficient conditions that certain invariants may be singularly invariant. In this connection a study is made of the average time limits of the invariants of motion. (tr-auth)

31587 GEOMETRICAL SCALING AND ANALYTICITY OF SCATTERING AMPLITUDES. Wit, R. (Jagellonian Univ., Krakow). Czech. J. Phys.; B26: No. 1, 102-104(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

Geometrical scaling connects, at $t = 0$, the phase of the Pomeron amplitude $F(s,t)$ to that of its derivative $\partial F(s,t)/\partial t$. This intrinsic phase correlation allows one to derive a dispersive sum rule which strongly relates the high- and low energy regions. (auth)

31588 GEOMETRICAL SCALING AND THE REAL PART OF THE POMERON. de Deus, J. D. (Rutherford Lab., Chilton, Eng.). Czech. J. Phys.; B26: No. 1, 92-95(1976).

From symposium on hadron–hadron scattering at high energies; Liblice, Czechoslovakia (16 Jun 1975).

Consequences of the hypothesis of geometrical scaling of the inelastic overlap functions applied to the Pomeron amplitude are discussed. From analyticity and crossing symmetry some predictions are given for the asymptotic real part of the Pomeron. (auth)

31589 IMPACT PARAMETER AND INFINITE-MOMENTUM FRAME KINEMATICS. Huszar, M. (Central Research Inst. for Physics, Budapest). Nuovo Cim., A; 31A; No. 2, 237-248(21 Jan 1976).

A group-theoretical interpretation of the impact parameter within the framework of the Poincare group is given. To this end timelike representations of the Poincare group are reduced with respect to the subgroup of transverse Galilei boosts and light front translations. It is shown that the eigenvalues of operators $B_1 = (N_1 + M_2)/(p^0 - p^3)$, $B_2 = (N_2 - M_1)/(p^0 - p^3)$, can be interpreted as a relativistic generalization of the impact parameter. One- and two-particle impact-parameter states are introduced and it is shown that the expansion of the scattering amplitude in terms of these states reduces to the usual impact-parameter expansion. It is demonstrated that the quantities B_1, B_2 recover the familiar definition of the impact parameter in the front form of classical mechanics too. (auth)

31590 CALCULATION OF THE S-CHANNEL DISCONTINUITIES OF REGGEON GRAPHS. Czechowski, A. (Univ., Warsaw). Nuovo Cim., A; 31A: No. 4, 605-625(21 Feb 1976).

The s-channel discontinuities of the Mandelstam diagram and of the reggeon graphs containing the Gribov's triple-reggeon vertices are discussed. The results are in agreement with those of Abramovskii, Gribov and Kancheli. (auth)

31591 CONCEPTS OF MULTIPARTICLE TIME DELAY. Bollé, D. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742); Osborn, T.A. Phys. Rev. D 13: No. 2, 299-311 (15 Jan 1976).

This paper studies two concepts of time delay in a few-particle scattering. The first is a global time delay that refers to the total advancement or retardation of the entire wave-packet motion owing to the presence of interactions not contained in the asymptotic Hamiltonian. The second type, the angular time delay, is the early or late arrival of a particle in a counter subtending an angle θ with respect to the incident beam direction. In the two-body problem the magnitude of this time delay is known to be $(d/dE)\, f(E,\theta)$, where $f(E,\theta)$ is the scattering amplitude at energy E. We discuss the definition of these two kinds of time delay in the three-body problem. We provide a generalization of the relation between angular time delay and the scattering amplitude that is valid for elastic, rearrangement, and breakup scattering. The interdependence of these two kinds of multichannel time delay is established. Possible physical applications of the resulting theory are discussed. (auth)

31592 COMPARISON OF APPROXIMATE METHODS FOR MULTIPLE SCATTERING IN HIGH-ENERGY COLLISIONS. II. Nolan, A.M.; Tobocman, W.; Werby, M.F. (Physics Department, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. D 13: No. 2, 346-353 (15 Jan 1976).

The scattering in one dimension of a particle by a target of N like particles in a bound state has been studied. The exact result for the transmission probability has been compared with the predictions of the Glauber theory, the Watson optical potential model, and the adiabatic (or fixed scatterer) approximation. The approximate methods work well

only at energies well above the binding energy per target particle. The adiabatic approximation works best and the Watson optical potential model is second best. The Watson method is found to work better when the kinematics suggested by Foldy and Walecka are used rather than that suggested by Watson, that is to say, when the two-body t matrix is calculated with the nucleon-target reduced mass instead of the nucleon-nucleon reduced mass. (auth)

31593 THEORY OF FERMION EXCHANGE IN MASSIVE QUANTUM ELECTRODYNAMICS AT HIGH ENERGY. VI. SUMMATION OF DIAGRAMS. McCoy, B.M. (The Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794); Wu, T.T. Phys. Rev. D 13: No. 2, 508-512 (15 Jan 1976).

We conclude our study of fermion exchange in massive quantum electrodynamics at high energy by summing the leading contributions which have been computed in perturbation theory in the four preceding papers. (auth)

31594 SEMICLASSICAL APPROXIMATIONS FOR HIGH ENERGY SCATTERING. Waldrop, M. M. Jr. Madison, WI; Univ. of Wisconsin (1975). 164p. University Microfilms Order No. 75-19,100.

Thesis (Ph. D.).

In the following work the insights that classical, point particle dynamics gives us about quantum mechanics and quantum field theory are explored. An extensive review of material which may be unfamiliar to many readers is undertaken. In Chapter II Schwinger's functional techniques in quantum field theory are examined. Chapter III discusses the nonrelativistic semiclassical approximation. In each chapter one step of the two part process of first and second quantization that separates a quantum field theory from its classical analog is discussed. In Chapter IV a simple and elegant semiclassical approximation to the Dirac equation in an external electromagnetic field is developed. Chapter V develops a perturbation theory for the semiclassical approximation; while discussing the analyticity and convergence of the series it is found that semiclassical theory also provides some unique insights into the convergence of the familiar Born series. In Chapter VI, the eikonal limit of particle scattering in massive QED is discussed. Chapter VII is a look towards the future. Some of the deficiencies of our method are examined, and some new approaches which may overcome them are suggested. An outline is given for a semiclassical approach to the problem of quark confinement in non-Abelian gauge theories. (Diss. Abstr. Int., B)

31595 NONPLANAR DUAL MODEL WITH ARBITRARY INTERCEPT $\alpha(0)$. Kudryavtsev, V. A. (Inst. of Nuclear Physics, Leningrad). Yad. Fiz.; 23: No. 1, 207-217(Jan 1976). (In Russian)

Nonplanar symmetric dual N-particle amplitude is obtained for arbitrary $\alpha(0)$. The spectrum of the model is found to be wider than the spectrum of the conventional Veneziano model and also contains "ghosts". At values $\alpha(0) = 1, 2$ the "ghosts" are absent, at $\alpha(0) = -2$ the state spectrum coincides in form with that obtained by means of one component of the conventional oscillator operators $a_{n\mu}$ ($\mu = 0, 1, 2, \ldots, D$) in the Veneziano model instead of $D,D-1$ or $D-2$ components. (auth)

31596 IMPACT-PARAMETER EXPANSION OF THE VENEZIANO AMPLITUDE. Wienke, B.R. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. D 13: No. 3, 668-670 (1 Feb 1976).

An impact-parameter expansion of the Veneziano scattering amplitude is obtained and some analytic properties are briefly discussed. A simple asymptotic limit to the expansion is also furnished for large impact parameter. (auth)

31597 DUAL FOUR-POINT FUNCTIONS. Baker, M. (Department of Physics, University of Washington, Seattle, Washington 98105); Coon, D.D. Phys. Rev. D 13: No. 3, 707-712 (1 Feb 1976).

The properties of a phenomenologically useful dual amplitude and its similarity with composite-particle scattering amplitudes are discussed. (auth)

31598 DISCRETE TWO-VARIABLE EXPANSIONS OF PHYSICAL SCATTERING AMPLITUDES. Bystrický, J.; Lehar, F.; Patera, J. (DPhPE, Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France); Winternitz, P. Phys. Rev. D 13: No. 5, 1276-1283 (1 Mar 1976).

A model-independent method of performing energy-dependent scattering-amplitude analysis is presented. It makes use of previously developed two-variable expansions of scattering amplitudes but involves only summations and no integrals. The energy and angle dependence are displayed in known functions. The angle, as usual, figures in Legendre polynomials; the energy is contained in Gegenbauer polynomials, if the data analysis is performed over a finite energy region and in specifically constructed basis functions when the analysis concerns the entire energy region. The purpose of the expansions is to make it possible to analyze all data for a given two-body reaction simultaneously (for all energies and angles) and to store the obtained information in the expansion coefficients. These then characterize the dynamics of a specific reaction, rather than a certain kinematic situation. (auth)

31599 RESONANCE-SUM MODEL FOR REGGEIZATION IN THE SCATTERING OF PARTICLES WITH ARBITRARY SPIN. King, M.J. (Applied Physics Division, Argonne National Laboratory, Argonne, Illinois 60439); Durand, L.; Wali, K.C. Phys. Rev. D 13: No. 5, 1409-1429 (1 Mar 1976).

Using a field-theoretic description of nonzero-spin particles, we have obtained center-of-mass helicity amplitudes corresponding to pole terms in four-particle reactions with arbitrary-spin external particles. We have discussed how to construct a van Hove-Durand–type model starting from these helicity amplitudes (which have a well specified kinematic structure in the field-theoretic description). Special attention has been paid to boson-fermion scattering. Straightforward Reggeization of helicity amplitudes assuming linear trajectories is known to produce parity doubling. Because of the generalized MacDowell symmetry of the helicity amplitudes, cuts appear in the J plane which prevent the occurrence in our model of parity-degenerate states in the physical J plane. One cannot have a pure fermion Regge pole unaccompanied by cuts. This conclusion has important consequences on both fitting data using Regge formulas in, say, backward scattering in boson-fermion scattering and theoretical considerations such as dual bootstrap models. (auth)

31600 LOCAL COMPENSATION OF QUANTUM NUMBERS AND THE PHASE OF MANY-PARTICLE PRODUCTION AMPLITUDES. Weingarten, D. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 13: No. 5, 1474-1488 (1 Mar 1976).

We assume that two-body scattering processes occur only as the shadow of a class of many-particle production events and that the probability distribution of this class of events obeys the requirement of local compensation of quantum numbers. The first of these assumptions implies that a certain functional integral yields the strongest bound on the energy dependence of two-body quantum-number exchange which can be obtained from inelastic production probabilities. Using the second assumption we evaluate this bound and show that recent data imply that the result for charge exchange is probably much weaker than the observed energy dependence actually observed. We therefore conclude the energy dependence of charge exchange should be generated mainly by the phase of many-particle production. Then we reformulate local compensation of quantum numbers as a condition on many-particle production amplitudes, including their phases. We show that this assumption implies the leading energy dependence of two-body quantum-number exchange is given by Regge poles with factorizable residues. of both charge and momentum transfer and can be extrapolated to provide a number of semiquantitative conclusions concerning exotic meson trajectories. (auth)

31601 RELATIVISTIC PARTIAL-WAVE ANALYISIS FOR THREE-MESON SYSTEMS. II. Lock, J.A. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. D 13: No. 4, 1009-1020 (15 Feb 1976).

We extend our relativistic partial-wave analysis to the $I > 0$ channels of the three-pion system. For the sake of definiteness, we apply our general procedure to the minimal-dynamics K-matrix model. In particular, we first generate properly symmetrized three-pion states using a group-theoretical approach. Using these, we then construct symmetrized scattering amplitudes and develop the minimal-dynamics K-matrix equations satisfied by the operators which enter into the symmetrized amplitudes. We find that for the $I = 1$ channel of the three-pion system, the $i_{ij} = 0,2$ subsystem isospin channels contribute to the scattering amplitude on the same footing as does the $i_{ij} = 1$ subsystem isospin channel. Thus the calculated properties of $I = 1$ three-pion resonances may be as dependent on the $i_{ij} = 0$ phase parameters as on the $i_{ij} = 1$ phase parameters which were assumed to be dominant in a number of previous calculations. (auth)

31602 HIGH-ENERGY AMPLITUDES OF YANG-MILLS THEORY IN THE EIGHTH ORDER. Lo, C.Y. (Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Cheng, H. Phys. Rev. D 13: No. 4, 1131-1133 (15 Feb 1976).

We give the asymptotic forms of the eighth-order amplitudes for both fermion-fermion scattering and vector-vector scattering in the Yang-Mills theory with an isospin-1/2 Higgs boson, in the limit $s \to \infty$ with t fixed. (auth)

31603 COMMENT ON THE NEW SCALING HYPOTHESIS OF DAO *et al.* AT ASYMPTOTIC ENERGIES. Yaes, R.J. (Department of Physics, Memorial University of Newfoundland, Canada A1C 5S7). Phys. Rev. Lett. 36: No. 14, 821-823 (5 Apr 1976).

I use the energy-momentum-conservation sum rules to investigate the consequences of the assumption that the "New Scaling Hypothesis" of Dao *et al.*, is valid at asymptotic energies for which $p_L \gg p_T, m$. Assuming that Koba-Nielsen-Olesen scaling, limited p_T, and the slow rise in

multiplicity with energy also remain valid asymptotically, I obtain a scaling relation for the invariant inclusive distribution which is inconsistent with ordinary Feynman scaling, but consistent with the violation of Feynman scaling at $2p_{LS}^{-1/2}=0$ recently found. (auth)

31604 NONCOUPLED INTEGRAL EQUATIONS FOR THE PHYSICAL THREE-PARTICLE AMPLITUDES. Bollé, D. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 13: No. 6, 1809-1812 (15 Mar 1976).

Starting from the Karlsson-Zeiger and the Osborn-Kowalski equations, we derive several sets of *noncoupled* integral equations for the physical three-particle amplitudes. We also obtain these sets from the Alt-Grassberger-Sandhas equations. We discuss the specific properties and advantages of these noncoupled equations. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

31605 "SPONTANEOUS" ACCELERATION OF FREELY ROTATING HELIUM II AND RELATED PHENOMENA IN PULSARS. Tsakadze, D.S.; Tsakadze, S.D. (Physics Institute, Georgian Academy of Sciences). JETP Lett. 22: No. 5, 139-140 (5 Sept 1975).

It is shown that a decelerating rotating vessel with helium II can become accelerated jumpwise without external action. (auth)

31606 DISSIPATIVE EFFECTS IN THE LONGITUDINAL MAGNETIC OSCILLATIONS OF SUPERFLUID LIQUID ^{3}He-*A*. Ambegaokar, V.; Levy, M. (Laboratory of Atomic and Solid State Physics, and Materials Science Center, Cornell University, Ithaca, New York 14853). Phys. Rev. B 13: No. 5, 1967-1970 (1 Mar 1976).

A theory of relaxation in the longitudinal magnetic ringing of the *A* phase of superfluid liquid ^{3}He is presented. An attempt is made to compare the theory with some recent experimental data. Some features of the data are in semiquantitative accord with the theory, but there are unresolved discrepancies about which some comments are made. (auth)

31607 SPECIFIC HEAT OF NORMAL AND SUPERFLUID ^{3}He ON THE MELTING CURVE. Halperin, W.P.; Archie, C.N.; Rasmussen, F.B.; Alvesalo, T.A.; Richardson, R.C. (Laboratory of Atomic and Solid State Physics, and Materials Science Center, Cornell University, Ithaca, New York 14853). Phys. Rev. B 13: No. 5, 2124-2131 (1 Mar 1976).

A method has been developed for determining the specific heat of liquid ^{3}He on the melting curve as a function of temperature and magnetic field. This approach depends on the accurate measurement of pressure and volume responses to heat pulses applied to the ^{3}He in a Pomeranchuk cell. Analysis of a number of different experiments at a particular melting pressure yields both the specific heat of the liquid and its temperature. The thermodynamic determination of the temperature has been separately discussed in another publication. Measurements were performed between 1.1 and 23 mK in magnetic fields up to 8.8 kOe. From the normal-fluid specific-heat data the low-temperature value of the effective mass at the melting curve was found to be $m^*/m = 5.5 \pm 0.2$. This is substantially smaller than that reported by Wheatley. Specific-heat discontinuities at the *A*, A_1, A_2, and *B* superfluid transitions have been measured. These give values for certain combinations of the coefficients of the fourth-order invariants in a Ginzburg-Landau expansion. Comparison was made with the predictions of spin-fluctuation theories. It was found that these alone cannot account for the behavior of ^{3}He at melting pressures. The entropy difference between the *A* and *B* phases was calculated from the specific-heat data and compared with that calculated from (i) measurement of the latent heat at the $B \rightarrow A$ transition, and (ii) measurement of the suppression of the *B* transition by magnetic field, *B* phase susceptibility data, and a magnetic Clausius-Clapeyron equation. The different methods give a consistent picture in which the thermal differences between *A* and *B* phases are quite small. The *A*-phase specific heat at $T/T_c \sim 0.5$ appears to have a weaker dependence on temperature than that expected for the limiting low-temperature behavior of the Anderson-Brinkman-Morel state. (auth)

31608 DISPERSION OF ORBITAL WAVES IN THE *A* PHASE OF SUPERFLUID He^3. Volovik, G.E. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). JETP Lett. 22: No. 8, 198-200 (20 Oct 1975).

A linear dispersion law is derived for orbital waves in the *A* phase of He^3. (auth)

31609 ROTON PROPAGATION AND PHONON-ROTON SCATTERING IN He II. Narayanamurti, V.; Dynes, R.C. (Bell Laboratories, Murray Hill, New Jersey). Phys. Rev. B 13: No. 7, 2898-2909 (1 Apr 1976).

The propagation characteristics of high-energy excitations in He II are studied as a function of pressure, temperature, and frequency by means of a superconducting Sn fluorescent generator and a Sn tunnel detector and time-of-flight techniques. At saturated vapor pressure and low temperatures ($T \simeq 0.1$ K) and with the detector energy gap possessing its full value (~ 14 K), a single well-defined pulse is observed to arrive at a time corresponding to that expected for the first echo (three traverses of the cell) of a low-energy phonon. This "echo pulse" disappears as the pressure is raised to 10 ± 2 bar and one observes a driven roton second sound at higher pressures. The echo pulse is interpreted as arising from a collinear interaction near the detector of a low-energy phonon with "fast" rotons (group velocity approximately equals the sound velocity c_0) by means of a three-particle interaction (phonon + roton $\rightarrow$ roton) first suggested by Pitaevskii. The data indicate that this Pitaevskii process turns off at high pressures and only the four-particle process (phonon + roton $\rightarrow$ phonon + roton) remains. With increasing magnetic field on the detector, ballistic phonons are observed as expected. The scattering of these ballistic phonons and a cloud of rotons are probed by means of a novel double-pulse technique and provides strong evidence for the existence of this collinear three-particle interaction at low pressures. (auth)

31610 HELIUM II THERMAL COUNTERFLOW AT LARGE HEAT CURRENTS. Ladner, D.R.; Childers, R.K.; Tough, J.T. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. B 13: No. 7, 2918-2923 (1 Apr 1976).

Data for the temperature and pressure differences produced by the thermal counterflow of helium II in long capillaries are given and shown to define a region of nonlinear flow distinct from that described by Vinen. We suggest a simple modification of the Vinen theory associated with a secondary flow in the normal fluid and in good agreement with our data. The critical heat current for the onset of the secondary flow is shown to define a stability region in analogy to second-order phase transitions. (auth)

31611 EXACT MAGNETIC RINGING SOLUTIONS IN SUPERFLUID ^{3}He-*B*. Maki, K.; Ebisawa, H. (Department of Physics, University of Southern California, Los Angeles, California 90007). Phys. Rev. B 13: No. 7, 2924-2930 (1 Apr 1976).

In the field-free regime (i.e., simple turn-off experiment) the nonlinear equation describing the spin dynamics (i.e., the Leggett equation) for the Balian-Werthamer state is solved by quadrature. The ringing frequencies of the magnetization are determined for all values of $\Delta\omega_0/\Omega_B$ for a variety of spin configurations, where $\Delta\omega_0$ is the Larmor frequency associated with the turn-off field and Ω_B is the Leggett longitudinal resonance frequency. (auth)

31612 CRITICAL DYNAMICS OF HELIUM BELOW T_c. Siggia, E.D. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 13: No. 7, 3218-3221 (1 Apr 1976).

The frequency- and wave-number-dependent density correlation function has been calculated below T_c for the symmetric planar-spin model of helium to first order in $4 - d$. In the hydrodynamic limit, the ratio of the damping of second sound to its velocity is an order of magnitude smaller than was found by Tyson. The theoretical results seem consistent with the light-scattering measurements however. (auth)

31613 CIRCULATION AND ANGULAR MOMENTUM IN THE *A* PHASE OF SUPERFLUID HELIUM-3. Mermin, N.D.; Ho, T.-L. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853). Phys. Rev. Lett. 36: No. 11, 594-597 (15 Mar 1976).

It is shown that the curl of the velocity field generally identified with $\vec{v}_s$ in the *A* phase of superfluid ^{3}He is entirely determined in the absence of singularities by the spatial gradients of the order-parameter symmetry axis $\hat{l}$. As a simple application of this relation it is argued that in a texture of cylindrical symmetry in a volume *V*, the liquid should have a nonvanishing thermal-equilibrium orbital angular momentum of order $\rho_s Vh/M$. (auth)

Superconductivity

Refer also to abstracts 28998, 29983–29985, 30026, 30027, 30029, 30118, 30145, 30147, 30158, 30159, 30167, 30169, 30173, 30181–30184, 30189, 30231, 30234, 30238, 30239, 30251, and 30308.

31614 (IC-74-136) ON THE ANALOGY BETWEEN SUPERCONDUCTIVITY AND CHIRAL SYMMETRY BREAKDOWN IN THE COULOMB GAUGE. Aurilia, A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1974. 36p. INIS.

Spontaneously broken gauge theories which do not explicitly involve boson fields are studied. This work was motivated by, and justifies, some recent results pointing to a deep analogy between particle physics and superconductivity. Thus the BCS theory of superconductivity, including Coulomb effects, are compared in detail, with its relativistic generalization in the Coulomb gauge. The structure of the resulting equations is identical in both cases. The unity is best appreciated in terms of the Schwinger mechanism which leads to plasma oscillations in superconductivity and to massive spin-one particles in the relativistic case. The physical operator densities, such as charge and current densities, differ from those found by other authors concerned with the problem of gauge invariance. (auth)

31615 THERMAL CONDUCTIVITY OF SUPERCONDUCTORS IN THE INTERMEDIATE STATE: DIMENSIONAL EFFECT IN A LONGITUDINAL LAMINAR STRUCTURE. Sutter, J. M.; Rinderer, L. (Univ., Lausanne, Switzerland). Helv. Phys. Acta; 48: No. 4, 426-429(1975). (In French).

Results obtained for Pb and Sn in the calculation of the thermal

conductivity by considering the electron mean free path, the lengths of normal and superconducting lamellae, and the cyclotron radius for $H = H_c(T)$ are reported. The results obtained were compared with experimental results and show that for small values of the normal state there is good agreement for Pb. There is no agreement for Sn. (JSR)

31616 MAGNETIZATION AND PINNING PHENOMENA OF A JOSEPHSON JUNCTION: ANALOG MODEL METHOD TO SOLVE JOSEPHSON EQUATION. Yamashita, T.; Rinderer, L. L. (Univ., Lausanne, Switzerland). Helv. Phys. Acta; 48: No. 4, 419-423 (1975).

A mechanical analog method of solving the Josephson phase equation is used to study magnetization and pinning effects in Josephson junctions. (SDF)

31617 TYPE-I SUPERCONDUCTOR IN A SWITCHED-ON MAGNETIC FIELD. Schaffernak, A. F. (Brown, Boreu and Co., Heidelberg, Ger.). Arch. Elektrotech. (Berlin); 56: No. 3, 112-119 (Aug 1974). (In German with English Abstract).

The space/time distribution of the electromagnetic field values within a superconductor subjected to a suddenly applied external magnetic field is investigated, for a better technical understanding of the electromagnetic behavior. The field equations resulting from the London theory are solved for a semi-infinite superconductor, with some simplifications. The behavior of a normal conductor is obtained if the penetration depth is considered as infinite. Whereas in technical applications the period of time in which static field conditions are reached can be neglected in superconductors, in normal conductors it must sometimes be taken into account.

31618 RAMAN SCATTERING OF LIGHT OFF A SUPERCONDUCTOR. Cuden, C.B. (Instituto de Fisica, Universidade Federal da Paraíba, 58.000 João Pessoa, Brazil). Phys. Rev. B 13: No. 5, 1993-2002 (1 Mar 1976).

Raman scattering off a superconducting surface is formulated using Kubo's nonlinear response theory in a form suitable for systematic diagrammatic expansion. The effects of the sample surface are correctly taken into account. It is shown that in the presence of vacuum polarization processes, the contribution to the scattering efficiency from the density-density correlation function considered in the literature, is reduced. The relevant four-vertex parts, describing inelastic scattering of light by electronic excitations via intermediate interband states in a superconductor, are calculated. Frequency and temperature dependence of the relative scattering efficiency for the large momentum transfer (Pippard limit), and constant transition matrix elements, are obtained. The estimated magnitude of the total scattering efficiency is of the order of 10^{-11}. (auth)

31619 INVESTIGATIONS IN THE AREA OF APPLIED SUPERCONDUCTIVITY AT THE HIGH TEMPERATURE INSTITUTE OF THE USSR ACADEMY OF SCIENCES. Sychev, V. V. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 3, 11-17(1975). (In Russian).

A short review of the work conducted by the Department of Applied Superconductivity of the High-Temperature Institute of the USSR Academy of Sciences is presented. Experiments were undertaken on transitional processes in superconductive windings including the process of solenoid magnetization with changing current, the development, existence and propagation of normal zones in superconducting windings, effective resistance in non-ideal superconductors of the II type, concrete superconducting magnetic systems which generate a transverse field in a channel and superconducting energy accumulators for stationary energetics.

31620 POSSIBILITY OF GETTING BETTER SUPERCONDUCTORS. Barak, G.; Weger, M. (Hebrew Univ., Jerusalem). Helv. Phys. Acta; 48: 625-629(1975).

It is suggested that $Nb_3Ge_xMg_{1-x}$ with $x \simeq 2/3$ (if it exists in the A-15 phase) is a better superconductor than Nb_3Ge. This is corroborated by a LCAO calculation of the band structure and density of states function. (auth)

31621 TRANSITION FROM ABRIKOSOV VORTEXES TO JOSEPHSON VORTEXES. Likharev, K.K. (M. V. Lomonosov Moscow State University). Sov. Phys.—Solid State 17: No. 9, 1856-1857 (Sept 1975).

One-dimensional calculations are made on the vortex structure of type II superconductors by considering thin film bridges. (AIP)

31622 NON-MARKOFFIAN EFFECTS IN JOSEPHSON RADIATION. Bose, S.K.; Ng, D.T. (Department of Physics and Astronomy, Southern Illinois University at Carbondale, Carbondale, Illinois 62901). Phys. Rev. A 13: No. 4, 1548-1556 (Apr 1976).

Non-Markoffian effects in the Josephson-radiation linewidth are investigated by using the projection-operator formalism of Mori. The memory function as well as the frequency are calculated in perturbation theory. We develop formal expressions for these to order λ^4, λ being a perturbation parameter, and discuss the simpler results valid to order λ^2. (auth)

31623 TUNNELING CONDUCTANCE FOR SUPERCONDUCTING ALLOYS WITH 3*d* MAGNETIC IMPURITIES. Ginsberg, D.M. (Physics Department and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). Phys. Rev. B 13: No. 7, 2895-2897 (1 Apr 1976).

It is shown that the tunneling conductance curves of Woolf and Reif for quench-condensed In-Fe alloy films do not agree with values which are calculated from the theory of Shiba and Rusinov, which is supposed to describe magnetic impurities that interact strongly with the conduction electrons. Possible reasons for the discrepancy are presented. It is also suggested that the theory should be modified to take strong electron-phonon coupling into account in relating the pair-breaking parameter to the impurity concentration for Pb-Mn alloy films. This would not affect the good agreement between the observed tunneling curves for Pb-Mn films and the theory, which Chaba and Nagi have found previously. (auth)

31624 PHONON-INDUCED INCREASE IN THE ENERGY GAP OF SUPERCONDUCTING FILMS. Tredwell, T.J.; Jacobsen, E.H. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. B 13: No. 7, 2931-2942 (1 Apr 1976).

We have observed large increases in the critical current of Josephson junctions under 10-GHz phonon excitation. Eliashberg has predicted that absorption of microwaves in a superconducting film will increase the energy gap by creating a nonthermal quasiparticle distribution. We modify this theory for *phonon* absorption and calculate the increase in the critical current of a Josephson junction corresponding to the increase in the energy gap. We obtain good agreement between our data and the modified Eliashberg theory. We conclude that absorption of phonons of energy $\hbar\omega < 2\Delta\ (T)$ increases the superconducting energy gap. (auth)

31625 ATOMIC ORDERING AND T_c OF NARROW-BAND SUPERCONDUCTING ALLOYS. Appel, J. (I. Institut für Theoretische Physik, Universitaet Hamburg, 2 Hamburg, Germany). Phys. Rev. B 13: No. 7, 3203-3208 (1 Apr 1976).

We present a theoretical discussion for the transition temperature T_c of superconducting alloys taking into account both the effects of composition and of atomic order. T_c is found from the ensemble-averaged vertex equation for a Cooper pair written in the atomic representation. The application to new experimental data on the effect of long-range order on T_c of Nb_3Sn, V_3Au, and V_3Ga yields good agreement between theory and experiment. (auth)

31626 QUASI-ONE-DIMENSIONAL FLUCTUATION CONTRIBUTION TO ULTRASONIC ATTENUATION IN CLEAN TYPE-II SUPERCONDUCTORS ABOVE $T_c(B)$. Allender, D. (Department of Physics, Brown University, Providence, Rhode Island); Houghton, A. Phys. Rev. B 13: No. 7, 3215-3217 (1 Apr 1976).

We have calculated the effect of fluctuations on the ultrasonic attenuation in a clean bulk type-II superconductor at temperatures above the transition temperature and in magnetic fields near the zero-temperature upper critical field, where the fluctuations are effectively one dimensional. The result is a decrease in the attenuation which should be observable experimentally. The effect increases with increasing mean free path. (auth)

31627 FIRST-ORDER INTERACTION FORCE BETWEEN A DISLOCATION LOOP AND FLUX LINE LATTICE IN A TYPE-II SUPERCONDUCTOR. Pande, C.S. (Brookhaven National Laboratory, Upton, New York 11973). Appl. Phys. Lett. 28: No. 8, 462-463 (15 Apr 1976).

Exact analytical expressions are obtained for the elementary first-order (ΔV) interaction force between a dislocation loop and flux line lattice in a type-II superconductor, using the stress field of the flux line lattice. The interaction force initially increases as the square of loop radius R, but as R is increased further it has the periodicity of a Bessel function of first order, i.e., J_1. (auth)

31628 ORDER PARAMETER FLUCTUATIONS AND COLLECTIVE MODES IN SUPERCONDUCTORS. Carlson, R. V. Minneapolis; Univ. of Minnesota (1975). 199p. University Microfilms Order No. 75-27,137.

Thesis (Ph. D.).

Measurements of the frequency and wave vector dependence of the pair-field susceptibility and the dynamical structure factor of homogeneous, short mean free path aluminum films have been carried out. These measurements critically probe the dynamical nature of order parameter fluctuations in the vicinity of the superconducting phase transition. The pair-field susceptibility of an aluminum film is obtained by using a thin film tunneling junction in which aluminum is one electrode, and lead the other. At temperatures near T/sub c/ of aluminum, an excess current which is

a consequence of fluctuation induced pair tunneling is observed in the dc current-voltage characteristic of the junction. The order parameter structure factor, related to the imaginary part of the susceptibility by the fluctuation-dissipation theorem, is determined by dividing the excess current by the voltage. Two important results are found. The first is that at temperatures higher than the transition temperature of the aluminum film, the fluctuations of the order parameter can be described by a diffusive time-dependent generalization of the Ginzburg-Landau equation. A major discrepancy between theory and experiment does exist in the vicinity of the superconducting transition, in that the pair relaxation frequency falls well below the theoretical predictions. Possible explanations of this behavior are discussed. Below the transition temperature measurements of the structure factor (Fourier transform of the order parameter-order parameter correlation function) provide the first clear cut demonstration of the existence of a propagating, low frequency, order parameter collective mode which appears as a finite frequency peak in the structure factor. This mode has been identified with fluctuations in the phase of the order parameter and has a linear dispersion relation over the range in which it is observed. Existing theories do not adequately explain the behavior of the mode over the range of temperature and magnetic field in which it is observed. (Diss. Abstr. Int., B)

31629 MICROWAVE STUDIES OF SUPERCONDUCTING MICROBRIDGES. Rachford, F. J. Cleveland; Case Western Reserve Univ. (1975). 274p. University Microfilms Order No. 75-19,238.

Thesis (Ph. D.).

The properties of thin film superconducting rings containing microbridge sections have been studied at 9.24 GHz. The microbridge geometries studied include rectangular constrictions, "zero length butterfly" Dayem microbridges, and proximity effect weak-links. One effect, directly analogous to the response often noted at lower frequencies in such samples, was a periodic modulation of the sample impedance due to the passage of quantized flux through the constriction. This periodic response, which is of great interest in magnetometry is found to be significantly enhanced at 9.2 GHz. A modulation of the periodic signal which is related to the maximum rate of flux passage in our samples was also noted. The flux passage time in our samples is inversely proportional to the BCS gap parameter in good agreement with theory. At the onset of the current driven superconducting to normal transition, the appearance of hysteretic steps in the sample impedance is noted. These hysteretic steps are found to be directly analogous to similar steps detected in the dc I-V characteristics of similar microbridge structures. These steps are associated with the generation of phase slip sites in our microbridges and the hysteresis in drive current noted at the onset of such steps is a result of the persistence of non-equilibrium quasiparticles in the regions of phase slip. In addition, over a narrow temperature range just below the transition temperature of our tin films, a random switching is noted at the onset of the hysteretic steps. This switching phenomenon is visible as random transitions between a state where a persistent phase slip site is present in the sample and a state where the phase slip is not present. The time average switching rate is found to vary with temperature in a manner which strongly suggests a thermally activated process where the rate is found to be exponentially dependent on the mean field free energy of the samples. (Diss. Abstr. Int., B)

31630 ULTRASONIC ABSORPTION IN SUPERCONDUCTING STATE OF IMPURE TIN. Mahajan, S. K. (Univ. of Delhi). Indian J. Pure Appl. Phys.; 13: No. 8, 554-556(Aug 1975).

Oscillatory behavior of ultrasound has been observed in the superconducting state of impure tin. The oscillations are found to be dependent on the amplitude as well as the frequency of the sound wave. Oscillatory behavior is found to be more marked in the presence of strain and at low amplitudes of the ultrasonic wave. 1 table, 2 figures. (auth)

31631 MICROSCOPIC THEORY OF SUPERCONDUCTIVITY: VERIFICATIONS AND EXTENSIONS. Claeson, T.; Lundqvist, S. (Chalmers Univ. of Tech., Goteborg). Cesk. Cas. Fys.; 26: No. 1, 1-51(1976). (In Czech)

The microscopic theory of superconductivity was formulated in 1957 by Bardeen, Cooper and Schrieffer. A number of experiments confirming the theory were discussed in the original paper. The BCS theory led to further experiments, some of which provided a stimulus to extending the theory as far as a more realistic model of interaction is concerned. In this short survey the results of a few experiments that test the concepts of pairing, energy gap and phonon-mediated attraction are described. The main emphases are on the powerful tunneling method and the variation of the superconducting transition temperature with different physical and chemical parameters. (auth)

PHYSICS (NUCLEAR)

31632 *(NP-20851) NUCLEAR STRUCTURE GROUP ANNUAL* PROGRESS REPORT, JUNE 1974-MAY 1975. (Birmingham Univ. (UK). Dept. of Physics). Jun 1975. 163p. Dep. NTIS (US Sales Only) $6.75.

This is the first annual progress report of the Nuclear Structure Group of the University of Birmingham. The introduction lists the main fields of study of the group as: polarization phenomena and optical model studies using ^{3}He and ^{4}He probes; photonuclear physics; heavy-ion physics; and K-meson physics. The programme is related to particle accelerators at Birmingham, Oxford, Harwell and the Rutherford Laboratory. The body of the report consists of summaries of 38 experiments undertaken by members of the group. The third section contains 10 notes on instrumentation topics. (UK)

31633 (ORNL-5114) NUCLEAR DECAY DATA FOR SELECTED RADIONUCLIDES. Martin, M. J. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 54p. Dep. NTIS $5.50.

Contained in this report are tabulations of the atomic and nuclear radiations emitted by 194 radioactive nuclides. The nuclei included comprise most of those currently of interest in medical practice or research, health physics, industry, nuclear power, environmental impact studies, and as reference standards. Listed in tabular form are recommended values for half-lives, energies, intensities (probabilities per decay), and equilibrium absorbed-dose constants for each of the atomic and nuclear radiations emitted by these radioactive atoms. (auth)

31634 *(ORNL/TM-5249) MODIFICATION NUMBER ONE* TO THE COUPLED 100n-21 gamma CROSS SECTION LIBRARY FOR EPR CALCULATION. Ford III, W. E.; Santoro, R. T.; Roussin, R. W.; Plaster, D. M. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 33p. Dep. NTIS $5.00.

The EPR ANISN-formatted 100-group neutron and 21-group gamma-ray cross section library has been modified by the addition of data for 20 materials, by the addition of reaction cross sections for calculating tritium and helium production, and by the addition of kerma factors. The EPR 100-group master cross section library has been modified by the addition of data for 19 materials. Procedures used to generate these cross sections and the organization of the libraries are described.

31635 (ORO-4936-1) PROGRESS REPORT ON NUCLEAR SPECTROSCOPIC STUDIES, JUNE 1, 1975-MAY 31, 1976. Bingham, C. R.; Riedinger, L. L. (Tennessee Univ., Knoxville (USA)). 1 Mar 1976. Contract E(40-1)-4936. 81p. Dep. NTIS $5.00.

Progress is reported for research programs involving studies of decay, nuclear reactions, and energy level structure of nuclei. (SDF)

31636 TWO-PHOTON EXCITATION OF NUCLEI. Krasnov, I.V.; Shaparev, N.Y. (L. V. Kirenskii Institute of Physics, Siberian Branch, Academy of Sciences of the USSR, Krasnoyarsk). Sov. J. Quantum Electron. 5: No. 12, 1420-1422 (Dec 1975).

An analysis is made of the two-photon absorption of radiation by nuclei subjected to two opposed γ-ray fluxes. The absorption cross section has two maxima separated by the recoil energy. The higher maximum, of width Γ governed by the radiative damping, is associated with the recoilless absorption; the lower maximum, of width governed by the Doppler effect, describes the absorption in the presence of recoil. The low maximum makes it possible to attain low values of the parameter Γ/ω. (auth)

31637 RESOLUTION OF MULTIPLETS IN COMPLEX γ SPECTRA BY THE METHOD OF REGULARIZATION WITH DIFFERENT FORMS OF THE REGULIZER. Volkov, N. G.; Chubchenko, V. G.; Churakov, A. K. Prikl. Yad. Spektrosk.; No. 5, 24-29(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

A method is developed for the selection of the optimum value of the parameter of regularization which results in a special form of the regulizer and substantially improves the resolution of multiplets in the computer processing of complex γ spectra. (JSR)

Neutron Interactions with Matter

Refer also to abstracts 29397, 31021, 31022, and 31880.

31638 *(AD/A-009563) NUCLEAR REACTIONS AND THE* INTERACTION OF NEUTRONS WITH MATTER. Skobeltsyn, D. V. Translated from Tr. Fiz. Inst., Akad. Nauk SSSR; 63: 1-160(1972). 301p. (FSTC-HT-23-825-74). NTIS $9.25.

Theory of nonstationary thermalization of neutrons; Germanium γ-radiation detectors used in investigating the scattering of neutrons; Fast neutron collimator for measuring inelastic scattering by nuclei; Measurement of spectra of fast neutrons using photoemulsions with high energy resolution; Method of determining angular distributions in the scattering of fast neutrons using photoemulsions; Interaction of deuterons with tritium and helium-3 at low energies; Lithium-drifted silicon detectors; Experimental verification of a method for calculating photonuclear reaction cross sections based on mathematical statistics; Transfer of data from amplitude analyzer to Ural-11B electronic computer; Regularization in the problem of the cross sections of photonuclear reactions. (GRA)

31639 (CEA-CONF-3291) ABSOLUTE AND RELATIVE FISSION FAST NEUTRON CROSS SECTION MEASUREMENTS FOR ^{235}U AND ^{238}U. Cance, M.; Grenier, G. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). 1975. 16p. (In French). INIS.

From 3rd national Soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

The experimental technique used for these measurements is described. Then the first results are presented on the comparison between the various methods of using an ionization chamber and the measurement of the fission cross sections of ^{235}U and ^{238}U at 14.6 MeV. (FR)

31640 (EUR-5212) MORSE-E: A NEW VERSION OF THE MORSE CODE. Ponti, C.; van Heusden, R. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Dec 1974. 14p. INIS.

This report describes a version of the MORSE Code which has been written to facilitate the practical use of this program. MORSE-E is a ready-to-use version that does not require particular programming efforts to adapt the code to the problem to be solved. It treats source volumes of different geometrical shapes. MORSE-E calculates the flux of particles as the sum of the paths travelled within a given volume, the corresponding relative errors are also provided. (auth)

31641 (IAE-2325) DESIGN PROGRAMME COMPLEX OF SPACE-ENERGY AND ANGULAR DISTRIBUTIONS OF THERMAL NEUTRONS IN PLANE HETEROGENEOUS SYSTEMS-RULES OF PROGRAMME COMPLEX USAGE, TEXTS OF PROGRAMS DEMETRA-1. Part 2. Lyashenko, G. V.; Safin, Yu. A.; Trukhanov, G. Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 36p. (In Russian). INIS.

31642 (ORNL/TM-5220) ANALYSIS OF NEUTRON SCATTERING AND GAMMA-RAY PRODUCTION INTEGRAL EXPERIMENTS ON NITROGEN FOR NEUTRON ENERGIES FROM 1 TO 15 MeV. Cramer, S. N.; Oblow, E. M. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 63p. Dep. NTIS $4.50.

Two integral experiments of neutron scattering and gamma-ray production from nitrogen samples performed at Intelcom Radiation Technology and Oak Ridge National Laboratory were analyzed with Monte Carlo calculations. The experimental results include angular-dependent NE-213 detector count rates for both scattered neutrons and gamma-ray production from a spherical dewar of liquid nitrogen pulsed with a neutron beam with energies from 1 to 20 MeV. Additional results were reported in the ORNL experiments for unfolded scattered neutron and gamma-ray production spectra as a function of detector angle in broad incident neutron energy bins. Multigroup Monte Carlo calculations were made to analyze all the reported results. Conclusions were drawn about the status of the ENDF/B-IV nitrogen cross-section data file from the comparison of calculated and experimental results. 1 table, 44 figures. (auth)

31643 (ORO-4750-3) ASSESSMENT OF FLAT-FLUX AND FLAT-SOURCE APPROXIMATIONS IN GENERATING RESONANCE CROSS SECTIONS. Final Report. Karam, R. A.; Kirby, K. D. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). 1 Jul 1975. Contract AT(40-1)-4750. 49p. Dep. NTIS $4.00.

Effective resonance cross sections used in the analysis of heterogeneous reactors have generally been obtained through the use of equivalence theory and/or integral transport theory.

One fundamentally restrictive assumption common to equivalence theory and most integral transport methods is the flat-source approximation. The assessment of this approximation was recently completed and comprised the following: a. Comparison of the broad group cross sections of ^{238}U in the resolved resonance region using: i. the flat-source approximation ii. the exact source distribution iii. the rational approximation with a Levine type factor; b. Comparisons in (a) for three types of reactors: i. typical ZPR-assembly ii. LMFBR commercial power station iii. light-water power reactor. The main conclusion was that even though there were significant differences between the exactly calculated escape probabilities and those calculated with the flat-source approximation, additional differences between the general energy-dependent reciprocity and the energy-independent (but often erroneously applied as energy-dependent) reciprocity relation almost completely compensated for the error in the flat-source escape probabilities. Due to this unusual and somewhat unexpected compensating effect, the effective capture cross sections of ^{238}U in the resolved resonance region, generated by the three methods stated earlier, were essentially the same. 7 tables, 7 figures. (auth)

31644 TRANSMISSION PROBABILITY METHOD FOR NEUTRON TRANSPORT CALCULATIONS IN NON-UNIFORM REACTOR LATTICES. Mesina, M.; Emendoerfer, D. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Atomkernenergie; 26: No. 3, 163-168(1975).

9 figs.; 4 tabs.; 10 refs.

A method for solving the two-dimensional multigroup transport equation with anisotropic scattering is presented. The heterogeneous system is divided into homogeneous subregions, in which angular-dependent mean source and flux densities are defined. Working with an interface flux density coupling technique, the entire neutron transport can be described by generalized transmission probabilities only, without explicit use of escape probabilities. This method is applicable to geometrically complicated subregions (even concave ones), as far as the surface contour is approximated by a polygon. (DE)

31645 HIGH-ORIENTED PYROLYTIC GRAPHITE AS NEUTRON FILTER. Pt. 2. Second Order Neutron Filter. Heller, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)); Saad, M. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). Atomkernenergie; 26: No. 4, 274-275(1975).

3 figs.; 4 refs.

Neutron transmission measurements have been made from high-oriented pyrolytic graphite with mosaic spreads $\eta = 0.8^0$, 1.2^0 and 3.5^0 in the energy range between 1 meV and 1 eV. By tuning the graphite target with $\eta = 1.2^0$ slightly out of the position with its orientation axis parallel to the incident neutron beam the energy range for filtering against higher order contamination can be increased. Using a graphite filter with a small mosaic spread the sample thickness and therefore the loss of the transmitted first order neutrons with energy E can be reduced considerably for a required reduction of second order neutron with energy 4 E. However, a smaller mosaic spread is only advantageous with a precise adjustment and a higher energy resolution of the spectrometer. (DE)

31646 SOLUTION OF TWO-DIMENSIONAL DIFFUSION EQUATION FOR HEXAGONAL CELLS BY THE FINITE FOURIER TRANSFORMATION. Kobayashi, K. (Kyoto Univ. (Japan). Faculty Engineering). Atomkernenergie; 26: No. 4, 249-254(1975).

2 figs.; 2 tabs.; 8 refs.

A method of solution is presented for a monoenergetic diffusion equation in two-dimensional hexagonal cells by a finite Fourier transformation. Up to the present, the solution by the finite Fourier transformation has been developed for x-y, r-z and x-y-z geometries, and the flux and current at the boundary are obtained in terms of Fourier series. It is shown here that the method can be applied to hexagonal cells and the expansion of boundary values in a Legendre polynomials gives numerically a higher accuracy than is obtained by a Fourier series. (DE)

31647 NEUTRON RESONANCES IN ^{181}Ta AT 2 TO 70 eV. Belanova, T. S.; Kolesov, A. G.; Poruchikov, V. A.; Kalebin, S. M.; Artamonov, V. S. Sov. At. Energy (Engl. Transl.); 38: No. 6, 553-554(Jun 1975).

Translated from At. Energ.; 38: No. 6, 430-431(Jun 1975).

Measurements of σ_t for the isotope ^{181}Ta were made by the time-of-flight method at the SM-2 reactor. Metallic tantalum of high purity containing 99.9% ^{181}Ta was studied. Measurements were made with samples of three thicknesses: 132.5×10^{20}, 44.2×10^{20}, 5.5×10^{20} nuclei/cm^2. Resonance parameters of neutron levels in the energy range 2-70 eV were determined from the measured transmission. The statistical error of the measurements was $\leq 1.5\%$. The neutron background level was 1-2%. Up to 40 eV, the neutron resonance parameters were calculated by the shape method from the one-level Breit-Wigner formula, and by the area method above 40 eV. In using the area method, the value of the radiation width was assumed to be 65.5 MeV. 1 table. (auth)

31648 INTEGRAL TESTS OF NEUTRON CROSS SECTIONS FOR IRON, NIOBIUM, BERYLLIUM, AND POLYETHYLENE. Johnson, R. H. Urbana, IL; Univ. of Illinois (1975). 140p. University Microfilms Order No. 76-6811.

Thesis (Ph. D.).

An NE-213 neutron spectrometry system was developed for measurements of neutron spectra in the range of 1.0 to 15 MeV. Pulse-shape discrimination against gamma-ray events was used. A photomultiplier bridge design which gave both good pulse-height linearity and good pulse-shape discrimination was developed for this spectrometry system. Neutron spectra were obtained by unfolding measured pulse-height spectra. Measurements of Pu-Be and D-T neutron sources were performed as tests of this spectrometry system. This spectrometry system was used to measure the neutron energy spectrum of a ^{252}Cf spontaneous fission neutron source. Two measurements were fit with Maxwellian distributions for the energy range of 2.6 to 15.0 MeV. These fits yielded Maxwellian temperatures of 1.43 ± 0.05 MeV and 1.42 ± 0.03 MeV. Neutron leakage spectra were measured for the ^{252}Cf source in spheres of iron, niobium, beryllium, and polyethylene. The neutron leakage spectrum for the D-T source in the iron sphere was also measured. These leakage spectrum measurements were integral experiments and were used to test neutron cross sections. The measurements were compared with discrete ordinates calculations using several different cross section sets. Calculations based on ENDF/B-III data were in reasonably good agreement with the niobium, beryllium, and polyethylene measurements. Calculations for the ^{252}Cf source in the iron sphere were made using cross section sets based on ENDF/B-III and DNA (Mat 4180, Mod 2) data. Calculations for the D-T source in the iron sphere were made using the same cross section sets as for the ^{252}Cf source in iron. (auth)

31649 PERFORMANCE AND COMPARISON OF S_N COMPUTER PROGRAMS. Newsl. ENEA Comput. Programme Libr.; No. 18, 5-23(Apr 1975). (In English and Italian).

The experiences of various researchers with computer programs using the S_N method are compiled. Topics considered include the following: comparison of analytical S_N and discrete-power-series S_∞ calculations with the code ANISN; comments on transport codes by the author of SABINE; a comparison of ANISN and SABINE shielding calculations; coarse-mesh rebalancing acceleration for eigenvalue problems; discussions of the codes PALLAS and ANISN-EIR. (RWR)

31650 OPERATING EXPERIENCES ON CODE UTILIZATION. Newsl. ENEA Comput. Programme Libr.; No. 18, 25-30(Apr 1975).

Various occurrences encountered in the use of transport codes are discussed. These include the following: two cases of difficulties with the ANISN code due to hard-to-identify input errors; comments on the most common user errors in specifying data for the ANISN program, by the author of the program; two cases run with the program MC^2. (RWR)

31651 TIME DEPENDENT SPATIAL ENERGY SPECTRUM OF NEUTRONS IN AN ABSORBING, SLIGHTLY NON-HOMOGENEOUS HEAVY MEDIUM. Metelkin, E. V. At. Energ. (USSR); 40: No. 1, 45-48(Jan 1976). (In Russian).

The time-dependent, spatial energy spectrum of neutrons — from a pulsed, monochromatic point source — in an absorbing, slightly non-homogeneous, heavy medium is determined. An expression describing the density distribution of absorbed neutrons has been obtained. (5 references) (auth)

31652 NEW DIRECT POINT FLUX MONTE CARLO ESTIMATOR USING COMPENSATED ROTATIONAL SYMMETRY. Horowitz, Y. S.; Dubi, A.; Mordechai, S. (Ben Gurion Univ. of the Negev, Beersheva, Israel). Nucl. Sci. Eng.; 59: No. 4, 427-429(Apr 1976).

A new formulation of the Monte Carlo approach to particle transport problems is described by defining a direct point flux estimator that extracts information from "passage" points rather than "collision" points. The approach leads directly to the radically new concept of track rotation and provides a statistical framework in which it is possible to prove the validity of the track rotation concept in spherically symmetric configurations and the validity of the compensated track rotation concept in nonspherically symmetric configurations. The approach can lead to essentially infinite gains in efficiency over conventional analog Monte

Carlo methods that cannot directly estimate the flux at a point. (auth)

31653 CALCULATION OF NEUTRON ENERGY SPECTRUM AND NEUTRON FLUX IN THE VICINITY OF CONCRETE SHIELDS. Doerschel, B. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). Kernenergie; 18: No. 8, 253-259 (1975). (In German)

Neutron spectra in the vicinity of two-dimensional infinite concrete shields up to 80 cm thick have been calculated using the Monte-Carlo method. The spectra of passing and reflected neutrons have been studied as a function of primary spectrum (14 MeV, pile, and thermal neutrons) and of shield thickness. The spectral changes are characterized by both spectrum parameters and the functions of thermal, intermediate and fast neutrons in the flux density of passing and reflected or primary neutrons. (GC)

31654 APPLICATION OF WALSH FUNCTIONS TO NEUTRON TRANSPORT THEORY. Seed, T. J. Seattle; Univ. of Washington (1975). 130p. University Microfilms Order No. 75-28,439.

Thesis (Ph. D.).

The angular variable in the neutron transport equation is expanded in the orthogonal, complete, binary valued sets of Walsh functions. Investigations of the Walsh expansion of the neutron transport equation were made as an effort to develop efficient computational techniques which eliminate or mitigate the ray effects of the discrete ordinates approximation. (S/sub N/). Classical problems of one-speed, plane geometry, neutron transport with isotropic scatter are solved in the W/sub N/ approximation to order N equals 16. It is found that the W/sub N/ approximation is an excellent approximation near boundaries and for thin media. In general, the W/sub N/ method in plane geometry provides results with accuracy comparable to the S/sub N/ for representative problems. Diagnostic techniques are developed for determining the susceptibility of an approximation to ray effects. The Walsh approximation is shown to be susceptible to ray effects and equivalent to a particular quadrature set. Two dimensional analysis is performed by solving a problem type which accentuates ray effects. Various Walsh and mixed Gauss–Walsh quadrature sets are developed which mitigate the ray effects while retaining reasonable accuracy in the calculation of volumetric reaction rates. (Diss. Abstr. Int., B)

31655 VARIATIONS IN ENERGY DEPOSITION DISTRIBUTIONS IN COLLIMATED NEUTRON BEAMS. Hogeweg, B. (Bezondheidsorganisatie TNO, Rijswijk, Netherlands). pp 4-7 of REP Annual Report. Rijswijk, Netherlands; Gezondheidsorganisatie TNO (1975).

31656 NEUTRON TRANSPORT OPERATORS IN *C* AND L_2 SPACES. Busoni, G.; Mangiarotti, L. (Istituto Matematico "U. Dini", Università di Firenze, Viale Morgagni 67/A, 50134 Firenze, Italy); Frosali, G. J. Math. Phys. (N.Y.) 17: No. 4, 542-545 (Apr 1976).

We study the stationary neutron transport equation (in its integral form) in plane and spherical symmetry. The investigation is carried out in both L_2 and C spaces, by means of standard methods of functional analysis. The equivalence between the eigenvalue problems in the two spaces is proved, and the space *C* seems often to be more appropriate than L_2 for investigating the main properties of the eigenfunctions. Results of functional analysis are applied in establishing some properties of the eigenvalues and the eigenfunctions. Moreover, the continuous dependence of neutron flux on optical and spatial parameters is shown. (auth)

31657 MOMENTS METHOD CALCULATION OF THE ENERGY-DEPENDENT NEUTRON FLUX DUE TO A POINT-ISOTROPIC FISSION SOURCE IN AN INFINITE MEDIUM OF SODIUM. Morris, E. E. (Univ. of Notre Dame, IN). Nucl. Sci. Eng.; 59: No. 3, 246-260(Mar 1976).

The energy-dependent neutron flux has been calculated for a point-isotropic fission source as a function of distance from the source in an infinite medium of sodium. The results were obtained by the moments method. Energy spectra are presented graphically for five distances from the source between 0 and 8 m and for energies between 1 eV and 15 MeV. Error estimates due to causes other than cross section uncertainties or interpolations are made. The calculations are compared with a previously reported Monte Carlo calculation and with experimental measurements. Satisfactory agreement is observed. 17 figures, 4 tables. (auth)

31658 EFFECT OF ANISOTROPY IN SCATTERING ON NEUTRON ANGULAR FLUX INSIDE SLABS. Rangaswamy, L.; Kothari, L. S.; Ahmed, F. (Univ., Delhi). Nucl. Sci. Eng.; 59: No. 3, 261-270(Mar 1976).

For one-speed neutrons, an investigation has been made of the effect of anisotropy in the scattering kernel on their angular distribution at various space points inside slabs of different thicknesses. This has been done by solving the one-speed space-angle-dependent neutron transport equation for a pulsed source, by numerically iterating over the space and angle variables. It is found that the fundamental decay constant decreases with increasing anisotropy, the effect being more in thicker slabs. The effect of scattering anisotropy on the angular flux inside slabs, as well as on leakage flux, has been reported. For a specific scattering kernel, the variation of angular flux with thickness of the slab is also discussed. Some of these results have been compared with those based on P_1 and P_3 approximations. 2 tables, 4 figures. (auth)

31659 ANISOTROPIC NEUTRON TRANSPORT WITHOUT LEGENDRE EXPANSIONS. Odom, J. P.; Shultis, J. K. (Kansas State Univ., Manhattan). Nucl. Sci. Eng.; 59: No 3, 278-281(Mar 1976).

A technique to obtain the energy group-to-group transfer cross sections for neutron elastic scattering is presented. This method, which avoids the traditional Legendre polynomial expansions, can be used directly in a discrete ordinates formulation of the transport equation to give accurate numerical results for those situations in which the group-to-group transfer is highly anisotropic. 1 table, 2 figures. (auth)

31660 NEUTRON MODERATION AND DIFFUSION IN THE P_2 APPROXIMATION. Kozachok, I. A.; Kulik, V. V.; Pirogov, V. I. Sov. At. Energy (Engl. Transl.); 38: No. 3, 209-211(Mar 1975).

Translated from At. Energ.; 38: No. 3, 167-168(Mar 1975).

The equation for thermal neutron diffusion in the P_2 approximation is solved for a source with initial energy E_o = 1 MeV placed in water. Plotted results are compared with a diffusion-age calculation. (SDF)

31661 CALCULATION OF SECONDARY EFFECTS CREATED IN AIR BY NEUTRONS. Zhemerev, A. V.; Medvedev, Yu. A.; Metelkin, E. V.; Stepanov, B. M. Sov. At. Energy (Engl. Transl.); 38: No. 3, 222-224(Mar 1975).

Translated from At. Energ.; 38: No. 3, 174-176(Mar 1975).

A calculation is made of the energy intensity, absorbed γ ray energy, and the Compton electron current produced by the γ radiation initiated in air by neutrons through the reaction $^{14}N(n,\gamma)$ ^{15}N. The neutron source is assumed to be point, pulsed, isotropic, and monochromatic with $E \leq 100$ keV. (SDF)

31662 NEUTRON TRANSPORT IN A POLARIZED PROTON MEDIUM. Markov, A. V. Sov. At. Energy (Engl. Transl.); 38: No. 3, 231-233(Mar 1975).

Translated from At. Energ.; 38: No. 3, 179-181(Mar 1975).

A solution of the equations describing neutron transport in polarized proton media is obtained for a plane isotropic source emitting polarized neutrons in an infinite polarized proton medium. The case considered is that of a source emitting neutrons with a spin antiparallel to the proton spin with 100% polarization of the medium. (SDF)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 30556, 31638, 31687, 31916, 31918, 31937, and 31948.

31663 (CEA-CONF-3305) MONOKINETIC NEUTRON PRODUCTION BY DEUTERIUM AND TRITIUM GASEOUS TARGETS. Haouat, G.; Lachkar, J.; Sigaud, J.; Patin, Y.; Seguin, S. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92—Montrouge (France)). 1975. 16p. (In French). INIS.

From 3rd national Soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

Two gas targets, one filled with deuterium and the other with tritium, are presented which have been designed for the production of fast neutrons from the $D(d,n)^3He$ and $T(p,n)^3He$ reactions. Cooling for the entrance window is achieved by circulation of the gas itself for the deuterium target and by helium circulation in a double window system for the tritium target. The performance of each target with regard to allowable beam current, neutron flux and neutron energy spread is discussed for neutron energies ranging from 2 to 15 MeV. (FR)

31664 (COO-2218-17) FUSION CROSS SECTIONS AND REACTIVITIES. Miley, G. H.; Towner, H.; Ivich, N. (Illinois Univ., Urbana (USA)). 17 Jun 1974. 120p. Dep. NTIS $5.50.

Cross section and reactivity data are summarized for several important fusion reactions. Reactivities are included for both

Maxwellian plasmas and beam-Maxwellian target fusion. Equations, tabular and also graphical presentations are included for convenience in a variety of applications. (auth)

31665 (IC-74-120) ON THE STRUCTURE OF ^{4}He and ^{12}C NUCLEI. Wadia, W.; Moharram, S. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1974. 14p. INIS.

A wave function which is an admixture of the (0s) and (1s) states is found to account for the diffraction minimum of the form factor of elastic electron scattering by ^{4}He. Prink's cluster model for ^{12}C has been investigated by means of a convenient expansion procedure. The model is found to be substantially different from the classical alpha particle model and to account satisfactorily for the high-energy electron scattering data. Further, the connection between Brink's model and the shell model has been established. (auth)

31666 (INIS-mf-1930, pp 25-49) A SHELL-MODEL INVESTIGATION OF NEGATIVE-PARITY STATES IN THE A = 30-35 MASS REGION, Ch. 2. van Hienen, J. F. A. 11 Jun 1975.

38 refs., 6 tables, 2 figs.

In shell-model calculations on light nuclei and a measurement of the $^{18}O(2_1^+)$ magnetic dipole moment. (Rijksuniversiteit Utrecht (Netherlands)).

A shell-model calculation has been performed for negative-parity states with $T \leq 3/2$ in A = 30-35 nuclei. A $2s_{1/2}1d_{3/2}1f_{7/2}2p_{3/2}$ configuration space was used, restricted by allowing only one nucleon to occupy either the $1f_{7/2}$ or the $2p_{3/2}$ orbit. The parameters of the MSDI effective interaction were determined from a fit to 24 experimental energies. The spectroscopic factors calculated are in excellent agreement with experiment except for A = 30. Analogue-to-antianalogue M1 transitions are also well reproduced. Not all E1 and M2 transitions, however, agree with experiment.

31667 (INIS-mf-1930, pp 50-52) SOME REMARKS ON MAGNETIC DIPOLE MOMENTS IN LIGHT NUCLEI, Ch. 3. van Hienen, J. F. A. 11 Jun 1975.

14 refs., 1 table, 1 fig.; also published in Physics Letters B, v. 42 (1972), p. 301.

In shell-model calculations on light nuclei and a measurement of the $^{18}O(2_1^+)$ magnetic dipole moment. (Rijksuniversiteit Utrecht (Netherlands)).

Multi-shell mixed-configuration calculations employing various effective interactions show that for low-lying states the g-factor in $T_z = 0$ nuclei as well as the average of g-factors of corresponding states in mirror nuclei varies between +0.4 and +0.9 n.m. in rather good agreement with a pure j^n description; for excited states in even-even T = 0 nuclei, one finds g + +0.50 n.m. The results agree well with present experimental data on magnetic dipole moments of ground states and excited states.

31668 (ITP-74-74-E) SPIN STATES AND THE EQUATIONS OF MOTION FOR A FEW NUCLEONS. Simenog, I. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 16p. INIS.

The Schroedinger equations for the spatial parts of the wave functions of a four-nucleon system in all spin and isospin states are given. Expressions for the pair potentials belonging to certain Young's schemes in the case of an arbitrary number of particles are obtained. These expressions are applied to a five-nucleon system in state $S = 1/2$, $T = 1/2$. (auth)

31669 EXPERIMENT ON DOUBLY RADIATIVE THERMAL NEUTRON CAPTURE IN HYDROGEN. Wuest, N.; Gueven, H. H.; Kardon, B.; Seafarth, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Z. Phys., A; 274: No. 4, 349-351(Oct 1975).

2 figs.; 6 refs.

An upper limit of 1.5×10^{-4} was measured for the branching ratio of the double-photon to single-photon transition from the 2.2 MeV np capture state to the ground state of the deuteron. This result was obtained in a coincidence experiment with two Ge(Li) detectors. Based on the total cross section of 334.2 mb for the thermal neutron capture in hydrogen, the upper limit corresponds to a cross section of 49 μb for the two-photon emission in the energy region 46 to 2,177 keV. (DE)

31670 COMPARISON OF THREE MODELS FOR n-n QUASI-FREE SCATTERING. Foroughi, F.; Bovet, E. (Univ., Neuchatel, Switzerland). Helv. Phys. Acta; 48: No. 4, 577-584(1975). (In French).

For n-n quasi-free scattering, the results obtained with three models are compared: Ebenhöh's code, the impulse approximation and the residue of the breakup amplitude corresponding to the deuterium bound state. (auth)

31671 MAXIMUM-OVERLAP ORBITALS IN NUCLEI. Vojtik, J. (Inst. of Physical Chemistry and Electrochemistry, Prague); Zofka, J. Czech. J. Phys.; B26: No. 3, 243-249(1976).

A formulation of the maximum overlap requirement is given which brings the scheme conceptually closer to the Hartree-Fock method. A procedure of solving the necessary condition for the maximum overlap is suggested and the stability conditions for the solutions as well as some symmetry aspects to the method are discussed. Using the suggested procedure the hyperspherical wave function of ^{4}He as well as the shell model wave function of ^{18}F are analyzed. (auth)

31672 GROUND AND LOW LYING EXCITED STATES OF P-SHELL NUCLEI IN THE K-HARMONICS METHOD. Erokhin, K. M.; Orlova, N. V.; Smirnov, Yu. F.; Shitikova, K. V. (Moscow State Univ.). Yad. Fiz.; 22: No. 6, 1102-1109(Dec 1975). (In Russian).

Binding energies for a number of nonmagic p-shell nuclei are calculated in the lowest approximation of the K-harmonics method. The calculations are fulfilled with various nucleon-nucleon potentials. A detail comparison with the results obtained by means of the shell model is presented. (auth)

31673 LOW MOMENTUM ANTINEUTRON-PROTON CROSS SECTIONS. Gunderson, B. N. Madison, WI; Univ. of Wisconsin (1975). 108p. University Microfilms Order No. 75-28,794.

Thesis (Ph. D.).

The total and annihilation cross sections of antineutrons on protons were measured to better than 20% statistical accuracy in the momentum range 0.25-0.88 GeV/c by the transmission technique. The antineutron annihilation cross section on carbon was also measured. A broad spectrum antineutron beam, produced by charge exchange of a degraded 1 GeV/c antiproton beam, with antineutron momentum measured by time of flight, was attenuated by a carbon or heptane-base liquid scintillator target (CH_2). Elastic recoil proton kinetic energy was measured in the heptane and used to calibrate a Monte Carlo correction for elastic scattering. The $\bar{n}p$ total cross section is consistent, throughout the momentum range, with a fit, of the form $A + B/P_{lab}$, to the $\bar{p}p$ total cross section above 0.5 GeV/c. The presence of p-wave in the annihilation process, down to 0.25 GeV/c, is confirmed. The Glauber-Wilkin correction to the $\bar{p}d$ total cross section is verified to 20% in the momentum range. (Diss. Abstr. Int., B)

31674 ELASTIC SCATTERING OF $\pi^\pm$-MESONS ON ^{4}He IN THE ENERGY INTERVAL (68 TO 208) MeV. Shcherbakov, Yu. A. (Joint Inst. for Nuclear Research, Dubna, USSR); Angelescu, T.; Falomkin, I. V.; Kulyukin, M. M. Nuovo Cim., A; 31A: No. 2, 249-260(21 Jan 1976).

Differential cross section measurements of elastic scattering of $\pi^\pm$ on ^{4}He are presented. The experiment was carried out with the high pressure helium self-shunted streamer chamber surrounded by a hodoscope of scintillation counters. Measurements were fulfilled both for positive and negative pions at 68, 98, 135, 145 and 156 MeV, for negative pions also at 120, 174 and 208 MeV. The differential and total elastic scattering cross sections are compared with optical-model calculations using the Kisslinger and Laplacian potentials. Some results, obtained from an energy-dependent phase shift analysis, are also presented. (auth)

31675 ELASTIC SCATTERING OF $\pi^\pm$-MESONS ON ^{3}He IN THE ENERGY INTERVAL (68 TO 208) MeV. Shcherbakov, Yu. A. (Joint Inst. for Nuclear Research, Dubna, USSR); Angelescu, T.; Falomkin, I. V.; Kulyukin, M. M. Nuovo Cim., A; 31A: No. 2, 262-276(21 Jan 1976).

Differential cross section measurements of elastic scattering of $\pi^\pm$ on ^{3}He are presented. The study was done both for positive and negative pions at 98, 120, 135, 145, 156 MeV, for negative pions also at 198 and 208 MeV and for positive pions also at 68 MeV. The experiment was carried out with a high pressure helium self-shunted streamer chamber surrounded by a hodoscope of scintillation counters. The results are compared with optical-model calculations using spin- and isospin-dependent potentials. The energy dependence of the total elastic ($\pi^\pm$, ^{3}He) scattering cross section is discussed. Estimates of the (π ^{3}He ^{3}H) coupling constant according to the theory of Chew and Low are presented. (auth)

31676 *POLARIZATION TRANSFER IN p-^{3}He ELASTIC* SCATTERING. Hardekopf, R.A.; Armstrong, D.D. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). Phys. Rev. C 13: No. 3, 900-906 (Mar 1976).

Angular distributions of the polarization transfer coefficients $K_{x'}^{x'}$, $K_{z'}^{x'}$, and K_y^y (Wolfenstein parameters *R*, *A*, and *D*) were measured at 16.2 MeV for ^{3}He($\vec{p}$,$\vec{p}$) elastic scattering. The angular range covered was 30° to 90° (lab) in 10° steps. The experiment used a polarized proton beam of 150 to 200 nA, a liquid-nitrogen cooled ^{3}He gas target, and a ^{4}He-filled proton polarimeter. The transfer coefficients are well described by an *R*-matrix analysis of the *p*-^{3}He system. (auth)

31677 COMMENT ON OBSERVATION OF TWO-PHOTON DECAY IN *n-p* CAPTURE. Riska, D.O. (Department of Physics, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 13: No. 3, 1324-1325 (Mar 1976).

It is shown that nonorthogonality of $S=J=1$ nucleon-nucleon wave functions is probably not a valid explanation of the disagreement between the theoretical and experimental values for the cross section for $np \rightarrow d\gamma\gamma$. (auth)

31678 BREAKUP REACTIONS pd → ppn AND dd → dpn. Kluge, W. (Univ., Karlsruhe, Ger.). Fortschr. Phys.; 22: 691-774(1974). (In German).

A review is given of the experimental studies on breakup reactions and the possibilities of their analysis. The theoretical principles of these reactions are first discussed. The reaction mechanisms of the final-state interaction and the quasifree scattering typical for three body reactions are summarized. A review is given of the exact non-relativistic three-body theory. Typical experimental installations for studying these reactions are described. Measurement results obtained are reviewed and discussed. (115 references) (SJR)

31679 PROJECTED CONFIGURATION INTERACTION CALCULATIONS FOR LIGHT NUCLEI USING GAUSSIAN POTENTIALS. Miranda, D. M. New York; Fordham Univ. (1975). 149p. University Microfilms Order No. 76-4130.

Thesis (Ph. D.).

The general method of configuration interaction using projection operators, in a variation after projection, is studied in detail and applied to the calculation of the binding energies of ^{3}He and ^{6}Li. The properties of angular momentum projection operators and the evaluation of their matrix elements between product states are studied in detail. The method of constructing ortho-normalized symmetry-adapted wavefunctions with j-j coupled spherical harmonic oscillator functions as basis is studied. The reduction of the two-body matrix elements directly to a sum of Talmi integrals in the j-j scheme is given in detail for central, spin-dependent and tensor forces. This procedure does not require the use of transformation brackets or auxiliary Racah coefficients, and it is practical, therefore, to tabulate once and for all, the coefficients of the various Talmi integrals, for all the matrix elements one might reasonably require. A representative table for central and spin-dependent forces is given. The interactions used in the calculations were obtained by fitting a sum of Gaussians to the singlet and triplet low-energy, n-p scattering data, and ^{4}He and ^{16}O binding energies. Various pairs of singlet and triplet potentials have been obtained. The methods developed are analytical and straightforward and can be applied to the study of several properties of low-lying states of light nuclei, and with complete automation can be easily extended to heavier nuclei. (Diss. Abstr. Int., B)

31680 FORMATION OF π MESONS BY PHOTONS ON ^{3}He IN THE CURRENT ALGEBRA MODEL. Serdyutskii, V. A.; Tabachenko, A. N. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 96-102(1975). (In Russian).

The process of photoproduction of π mesons on ^{3}He is examined in the hard π meson current algebra model. The process amplitude was obtained by means of the Ward identity which follows from the hypothesis on the partial conservation of axial-vector current and current algebra. In sums by the intermediate states only the π meson and the ^{3}He and ^{3}H nuclei were considered. The significant role of contact terms for explanation of the experimental data was noted. The calculated differential cross section of the photoproduction of π mesons on ^{3}He agrees satisfactorily with experimental data at low energies ($E_\gamma < 240$ MeV) and small transmitted pulses ($|t| < 2.5\ \phi^{-2}$). (tr-auth)

31681 PARITY-NONCONSERVING EFFECTS IN THERMAL NEUTRON CAPTURE BY PROTONS AND THE SHORT-RANGE BEHAVIOR OF THE STRONG TWO-NUCLEON FORCE. Craver, B.A.; Fischbach, E.; Kim, Y.E.; Tubis, A. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 13: No. 5, 1376-1389 (1 Mar 1976).

P_γ, the photon circular polarization in np radiative capture at thermal energies, is calculated for a class of weak-interaction Hamiltonians and several short-range phase-equivalent transformations (PET's) of the Reid soft-core potential. The calculations, which are exact except for the usual first-order approximation in the weak interaction, are facilitated by the use of Green's function techniques. An error in the form of the electromagnetic-interaction Hamiltonian H_{em} that has appeared in the literature is also corrected. For the Reid soft-core potential and the Cabibbo model $P_\gamma = +2.28 \times 10^{-8}$. For a given weak Hamiltonian it is found that nonlocal PET's of the Reid potential may increase P_γ by as much as an order of magnitude. For the PET's considered the enhanced values of P_γ are all positive. This extreme sensitivity to the short-range two-nucleon potential, and the discrepancy in sign between the experimental value $P_\gamma = -(1.30 \pm 0.45) \times 10^{-6}$, and theoretical predictions, greatly complicates attempts to use the study of P_γ to discriminate among weak-interaction Hamiltonians. (auth)

31682 COMPILATION OF RESONANCE INTEGRALS. I. Z = 1-52 (HYDROGEN-TELLURIUM). Gryntakis, E. M.; Kim, J. I. (Technical Univ., Munich). J. Radioanal. Chem.; 29: No. 1, 175-224(1976)

The resonance integrals of reactor neutron capture reactions for nuclides up to Z = 52 are compiled, while the thermal cross sections of the corresponding nuclides are also included. The original values from the literature and the normalized ones for the excess of 1/v tailing are presented in parallel. The physical meaning of resonance integral obtained by different experimental approaches is briefly discussed. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 31661, 31666, 31667, 31671–31673, 31679, 31682, 31685, 31696, 31697, 31734, 31742, 31746, and 31918.

31683 (CRN-PN-75-32) STUDY OF ^{12}C(α,^{8}Be)^{8}Be AND ^{16}O(α,^{8}Be)^{12}C REACTIONS. Rudolf, Gerard. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). 1975. 122p. (In French). INIS.

Excitation functions at several angles and numerous angular distributions of the ^{12}C(α,^{8}Be) and ^{16}O(α, ^{8}Be) reactions have been measured for E(α) = 16-33 MeV and E(α) = 17-25 MeV, respectively. A high Be detection efficiency has been obtained with a set-up using rectangular detectors. The mechanism of the ^{12}C(α, ^{8}Be)^{8}Be reaction appears to be close to the one of some low energy heavy-ion reactions like ^{12}C + ^{12}C or ^{12}C + ^{16}O About twenty resonances have been studied through the ^{16}O(α, ^{8}Be)^{12}C reaction; a rotational band of mixed parity, and with a very strong moment of inertia was found at E(x) approximately 20 MeV in ^{20}Ne. (FR)

31684 (IFA-NR-55-1975) LINE SHAPE ANALYSIS OF THE FIRST EXCITED STATE OF ^{7}Li. Dorobantu, V. T.; Popa, M. S.; Apostolescu, S. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 7p. INIS.

The lifetime of the 477.6 keV level of ^{7}Li has been measured using the ^{10}B(n,α) Li reaction and the line shape technique. A lifetime of 86 ± 10 fsec was obtained. (auth)

31685 (INIS-mf-1791) ANNUAL REPORT OF THE NUCLEAR PHYSICS GROUP. Jan. 1 1974–Dec. 31 1974. (Auckland Univ. (New Zealand). Dept. of Physics). Feb 1975. 9p. INIS.

The work of the nuclear physics group at the University of Aukland is summarized. List of publications, conference papers presented and staff are also given.

31686 (INIS-mf-1930, pp 7-24) SHELL-MODEL CALCULATIONS IN A = 23-28 NUCLEI, Ch. 1. van Hienen, J. F. A. 11 Jun 1975.

39 refs., 5 tables, 11 figs.; published also in Nuclear Physics A, v. 225 (1974), p. 119.

In shell-model calculations on light nuclei and a measurement of the ^{18}O(2_1^+) magnetic dipole moment. (Rijksuniversiteit Utrecht (Netherlands)).

Energy levels, electromagnetic transition rates and multipole moments have been calculated for positive parity states in A = 23-28 nuclei in an untruncated $1d_{\frac{5}{2}}2s_{\frac{1}{2}}$ configuration space. The results obtained by considering all two-body matrix elements as free parameters (FP) are compared with those obtained with matrix elements from a realistic Hamada-Johnston interaction (HJ). The binding and excitation energies as well as strong B(E2) values calculated with RP and MSDI are found to be rather similar and in good agreement with experiment, in contrast to the B(M1) values. Poor agreement with experiment is obtained for JH matrix elements.

31687 (INIS-mf-1930, pp 53-66) A TRANSIENT FIELD MEASUREMENT FOR ^{18}O IN Fe, CH. 4. van Hienen, J. F. A. 11 Jun 1975.

24 refs., 2 figs., 1 table.

In shell-model calculations on light nuclei and a measurement of the ^{18}O(2_1^+) magnetic dipole moment. (Rijksuniversiteit Utrecht (Netherlands)).

The integral precession of ^{18}O* recoiling into magnetized Fe has been measured at a recoil velocity of v/c = 0.021. The measured effect, $\Delta\theta = -2.7 \pm 0.2$ mrad, yields a negative sign for the g-factor of the first-excited 2^+ state. The magnitude of this effect is 2.2 ± 0.4 mrad larger than calculated with the Lindhard-

Winther theory and the known value of the g-factor. This enhancement is ascribed to contributions from unpaired polarized 1s and 2s electrons.

31688 *(ISN-75-24)* MULTIPOLARITY DISTRIBUTION IN ^{12}C AND ^{16}O NUCLEI UP TO 30 MeV EXCITATION ENERGY BY PROTON AND ALPHA INELASTIC SCATTERING. Buenard, M. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires; Grenoble-1 Univ., 38 (France)). 1975. 146p. (In French). INIS.

The high-lying states of ^{12}C and ^{16}O nuclei were investigated and the distribution of the different multipolarities extracted up to 30 MeV excitation energy. The fine structure of the giant dipole resonance was studied and the dipole cross section compared to those expected from the model of Satchler. Other multipolarities (2^+ 3^- 4^+ T = 0) were also observed. The observed cross sections exhibit a significant fraction of the sum rule (EWSR) but never exceed 50% (50% for 1^- T = 1, 20 to 40% for 2^+ T = 0, ~15% for 3^- T = 0 and ≤10% for 4^+ T = 0). The distribution observed compares fairly well with the one expected from nuclear structure calculations except for 2^+ T = 0 in ^{16}O where complete disagreement is observed between experiment and theory. (FR)

31689 ON α-CLUSTERING IN THE O 16 NUCLEUS. Wadia, W. (International Centre for Theoretical Physics, Trieste (Italy)); Hegab, M. K. H. (Cairo Univ. (Egypt). Dept. of Physics). Atomkernenergie; 26: No. 4, 269-273(1975).

7 figs.; 18 refs.

The ground state nuclear density of O 16 based on four α clusters in a tetrahedral configuration has been investigated. Model densities for an α cluster that would account for the polarizability of the α cluster inside the nucleus have been considered. An estimate of the resulting octupole deformation is given by comparison with electron inelastic scattering data and with the lifetime of the first excited 3^--level. (DE)

31690 OPTICAL MODEL ANALYSIS OF PROTON-CARBON ELASTIC SCATTERING IN THE RANGE 20 TO 50 MeV. Sprickmann, R.; Knoepfle, K. T.; Ingham, D.; Rogge, M.; Mayer-Boericke, C. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik); Geramb, H. V. (Melbourne Univ., Parkville (Australia). School of Physics). Z. Phys., A; 274: No. 4, 339-342(Oct 1975).

2 figs.; 2 tabs.; 7 refs.

The differential cross-sections for the elastic scattering of protons from ^{12}C with incident energies ranging in approximately 2 MeV steps between 20 and 50 MeV, are analyzed using a standard optical model. (DE)

31691 SOME REMARKS ON ^{13}N PHOTOPRODUCTION FOR ^{16}O AND ^{19}F AT INTERMEDIATE ENERGIES. Martins, J. B. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Tavares, O. A. P.; Terranova, M. L.; di Napoli, V. Lett. Nuovo Cim.; 15: No. 10, 364-368(6 Mar 1976).

The photoproduction of nitrogen-13 from oxygen-16 and fluorine-19 via (γ,p2n) and (γ,2p4n) reactions respectively is considered for the study of spallation. The cross sections for the yield are discussed. It is concluded that in the case of reactions induced by photon beams in the energy range 0.3 to 1.0 GeV, the probability exists of finding a large amount of nuclides still having an excitation energy of at least 3.5 MeV at the end of the spallation process. (JFP)

31692 CHARGE-EXCHANGE SCATTERING OF 60-MeV π^+ MESONS BY CARBON AND OXYGEN NUCLEI WITH EMISSION OF A PROTON. Gismatullin, Yu. R.; Lantsev, I. A.; Ostroumov, V. I. (Leningrad Polytechnic Inst.). Yad. Fiz.; 22: No. 6, 1073-1078(Dec 1975). (In Russian).

The nuclear emulsion method is used to study the (π^+, π^0p) reaction on carbon and oxygen nuclei at 60 MeV energy of π^+ mesons. The integral reaction cross section, the momentum and angular distribution of the recoil nuclei, the energy and angular distributions of protons are obtained. The experimental distributions for 60- and 112-MeV π mesons are compared with pole calculations. It is shown that at small recoil momenta (less than 150 MeV/c) the pole diagram with a virtual neutron dominates. At higher momenta the contribution from the pole diagram with a virtual nucleus grows when the meson initial energy increases. The contribution of the inelastic coherent π meson scattering by a nucleus to the (π^+, π^0p) reaction cross section increases when going from 112 to 60 MeV energy. (auth)

31693 ION–ION OPTICAL POTENTIALS WITH ACCOUNT OF INTERNAL STRUCTURE OF COLLIDING NUCLEI. Vershinin, G. A.; Cherdantsev, P. A.; Chernov, I. P. (Tomsk Polytechnic Inst., USSR). Yad. Fiz.; 22: No. 6, 1150-1161(Dec 1975). (In Russian).

To describe elastic scattering of multi-charge ions the ion–ion potentials are calculated by means of convolution of the real part of the phenomenological one-nucleon optical potential for one nucleus with nucleon density in another nucleus and in framework of the two-center model. In the last case the effect of dynamical deformation of the colliding nuclei is taken into account and it is shown that the potentials depend essentially on the choice of parametrization of the nuclear surface shape. The differential cross sections are analyzed and are very sensitive to the absolute value of real part of the optical potential in surface region at scattering of ^{16}O ions on nuclei ^{40}Ca, ^{58}Ni, ^{88}Sr with energy near the Coulomb barrier. As well a sharp increase of cross sections at backward angles at scattering of ^{16}O on ^{12}C with energies essentially higher than the Coulomb barrier is discussed. Comparing the calculated and the phenomenological potentials one deduces a conclusion on possible configurations of the system during the collision. (auth)

31694 OSCILLATIONS IN THE EXCITATION FUNCTION FOR COMPLETE FUSION OF $^{16}O+^{12}C$. Sperr, P.; Vigdor, S.; Eisen, Y.; Henning, W.; Kovar, D.G.; Ophel, T.R.; Zeidman, B. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 36: No. 8, 405-408 (23 Feb 1976).

The total fusion cross section for the $^{16}O+^{12}C$ system has been measured in the ranges 13 MeV ≤ $E_{c.m.}$ ≤ 27 MeV. The cross section is found to increase with bombarding energy up to $E_{c.m.}\simeq 17$ MeV but to stay roughly constant at higher energies, in qualitative agreement with predictions of current models. Superimposed on this average cross-section behavior we observe unexpected oscillations with a period of about 3–4 MeV (c.m. energy). (auth)

31695 MAGNETIC MOMENT BY HYPERFINE INTERACTION AND THE LIFETIME OF THE 1^- STATE IN ^{22}Na. Beck, F.; Dar, Y.; Forterre, M.; Vivien, J.P. (Centre de Recherches Nucléaires, B.P. 20, Strasbourg-France). Phys. Rev. C 13: No. 3, 895-899 (Mar 1976).

The magnetic moment of the 1^-, 2210 keV state in ^{22}Na has been measured by a plunger technique utilizing hyperfine interactions. Fields originating from 2*s* and 2*p* electrons were included. By comparison with previous ^{16}O data, population probabilities of the *L* subshells seem to be different from statistical. The adopted gyromagnetic factor is $|g|=0.36\pm0.07$, the error representing mostly possible systematic uncertainties involved in the specific atomic model used. As a byproduct, the lifetime of the 1^-, 2210 keV ^{22}Na level was remeasured, yielding $\tau=22.0\pm0.8$ ps. (auth)

31696 GIANT RESONANCE REGION OF ^{15}N STUDIED BY POLARIZED AND UNPOLARIZED PROTON CAPTURE MEASUREMENTS. Weller, H.R.; Blue, R.A. (University of Florida); Roberson, N.R.; Rickel, D.G.; Maripuu, S.; Cameron, C.P.; Ledford, R.D.; Tilley, D.R. Phys. Rev. C 13: No. 3, 922-932 (Mar 1976).

We have measured the cross sections and the analyzing powers for the $^{14}C(\vec{p},\gamma)^{15}N$ reaction for proton energies from 4.0 to 16.2 MeV. The corresponding range in excitation energies, 13.94 to 25.33 MeV, covers the region of the giant dipole resonance in ^{15}N. The five angular distributions measured with unpolarized and with polarized beams at eight energies over this region were analyzed to determine the magnitudes and relative phases of the transition matrix elements. The analysis included *E*1, *M*1, and *E*2 transitions. The observed *E*1 strength exhausts only about 5% of the classical dipole sum rule. The dominant *E*1 strength is compared to a shell-model calculation which includes 3p-3h excitations. A fairly uniform distribution of *E*2 strength is observed which exhausts about 7% of the total energy-weighted sum rule. Although large uncertainties on this result could allow the existence of a giant *E*2 resonance, the most probable values indicate that no appreciable concentration of *E*2 strength is observed. (auth)

31697 ENERGY LEVELS OF ^{12}N. Maguire, C.F.; Hendrie, D.L.; Scott, D.K.; Mahoney, J. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Ajzenberg-Selove, F. Phys. Rev. C 13: No. 3, 933-936 (Mar 1976).

A study of the excited states of ^{12}N has been made using the $^{12}C(^3He,t)^{12}N$ reaction at $E(^3He)=49.3$ MeV and the Berkeley magnetic spectrometer. We confirm a state of $E_x=2.415\pm0.020$ MeV, $\Gamma_{c.m.}=45\pm15$ keV, and we report four new states $^{12}N^*$ (6.10, 7.13, 9.42, 9.90) with $\Gamma_{c.m.}\sim0.3$, 0.5, ~0.2, and 0.1 MeV. Comparison with earlier ($^3He,n$) work reveals some inconsistencies, and comparison with the analog region in the mirror nucleus ^{12}B shows that the structure of ^{12}N remains poorly known. (auth)

31698 $^{12}C(\alpha,^8Be)^8Be$ REACTION IN THE ENERGY RANGE $E_\alpha=17$–33 MeV. Brochard, F.; Chevallier, P.; Disdier, D.; Rauch, V.; Rudolf, G.; Scheibling, F. (Centre de Recherches Nucléaires and Université Louis Pasteur, Strasbourg, France). Phys. Rev. C 13: No. 3, 967-975 (Mar 1976).

Excitation functions and angular distributions for the $^{12}C(\alpha,^8Be)^8Be$ reaction were measured for $E_\alpha=17$–33 MeV. Only broad

structures were observed, except for a narrow resonance at $E_\alpha = 22.30$ MeV. Total and L-partial cross sections are deduced from the angular distributions. Below $E_\alpha = 20$ MeV no $J = 8$ resonance was found. For higher energies an $L = 8$ contribution appears, increases gradually, and becomes dominant at and above $E_\alpha = 23$ MeV. A tentative interpretation of the behavior of $^{12}C(\alpha, ^8Be)^8Be$ partial cross sections is given in the framework of the Hauser-Feshbach formalism. (auth)

31699 GIANT RESONANCES OBSERVED IN THE SCATTERING OF 96- AND 115-MeV ALPHA PARTICLES. Youngblood, D.H.; Moss, J.M.; Rozsa, C.M.; Bronson, J.D.; Bacher, A.D.; Brown, D.R. (Cyclotron Institute and Physics Department, Texas A & M University, College Station, Texas 77843). Phys. Rev. C 13: No. 3, 994-1008 (Mar 1976).

Beams of 96- and 115-MeV α particles were used to study the giant resonance region in 27 nuclei ranging from ^{14}N to ^{208}Pb. A prominent broad ($\Gamma = 3$–7 MeV) peak is present in the spectra at an excitation energy of $\sim 63/A^{1/3}$ MeV for all nuclei studied with $A \geq 36$. No such prominent peak is apparent for $A < 32$. The angular distributions of the peak are characterized by an oscillatory behavior which is quite different from the monotonic behavior of the background. Distorted wave calculations with $L = 2$ reproduce the experimental angular distributions quite well for most of the nuclei. Energy-weighted sum rule fractions range from 30–50% for the lighter targets to near 100% for the heavier targets. Distorted wave calculations with a breathing mode ($L = 0$) form factor fail to reproduce the observed resonance strength by about a factor of 3 for all targets. The width of the peak is smallest for the closed shell nuclei ^{40}Ca, ^{90}Zr, ^{144}Sm, and ^{208}Pb. A small but significant broadening is observed in the rare-earth region of deformed nuclei. The giant dipole resonance is not appreciably excited for any of the targets. (auth)

31700 MEASUREMENT OF THE MASS OF ^8C BY THE $^{14}N(^3He, ^9Li)$ REACTION. Robertson, R.G.H. (Cyclotron Laboratory and Physics Department, Michigan State University, East Lansing, Michigan 48824); Benenson, W.; Kashy, E.; Mueller, D. Phys. Rev. C 13: No. 3, 1018-1023 (Mar 1976).

The mass of the particle-unstable $T_z = -2$ nuclide ^8C has been measured by means of the $^{14}N(^3He, ^9Li)$ reaction, which has an observed cross section of about 5 nb sr^{-1} at 76 MeV. The mass excess found is 35.06 ± 0.05 MeV, and the width of the ^8C ground state is 290 ± 80 keV. The result for the mass excess is more precise than that obtained in a previous $(\alpha, ^8He)$ experiment and confirms that significant higher order terms must be added to the isobaric multiplet mass equation to describe the mass-8 isobaric quintet. (auth)

31701 RESONANT STRUCTURES IN THE $^{12}C(^{12}C, ^8Be)^{16}O$ REACTION, $E_{c.m.} = 9$ TO 20 MeV. Fletcher, N.R.; Fox, J.D.; KeKelis, G.J.; Morgan, G.R.; Norton, G.A. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 13: No. 3, 1173-1179 (Mar 1976).

Coincident detection of α particles is used to measure the differential cross section of the $^{12}C(^{12}C, ^8Be)^{16}O$ reaction for $\theta_{c.m.} \simeq 12°$ to 68° and for each 100 keV interval from $E_{c.m.} = 9$ to 20 MeV. A large number of resonant enhancements is observed in the cross section and the J^π values of these are unambiguously determined. The energies and widths of some of these resonant structures agree with resonances reported in other exit channels, in particular those which have been interpreted as a quasimolecular collective band in ^{24}Mg. Well defined gross structure with $J = 8$, 10, and 12 is observed at $E_{c.m.} \sim 12$, 14.5, and 19 MeV. (auth)

31702 STATES IN ^{15}N POPULATED BY THE $^{11}B(^6Li, d)$ AND $^{11}B(^7Li, t)$ REACTIONS. Norton, G.A.; Kemper, K.W.; Moore, G.E.; Puigh, R.J.; Williams-Norton, M.E. (Department of Physics, Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 13: No. 3, 1211-1216 (Mar 1976).

Angular distributions have been measured in the angular range from 2.5° to 30° (lab) for the $^{11}B(^6Li, d)^{15}N$ and $^{11}B(^7Li, t)^{15}N$ reactions at $E(^{6,7}Li) = 34$ MeV. The $(^7Li, t)$ reaction is slightly more selective than the $(^6Li, d)$ reaction, but neither reaction has the selectivity of three-particle transfer reactions which also populate states in ^{15}N. The shapes of the measured angular distributions were not sufficiently distinctive to permit L transfer values to be extracted for the most strongly excited states. The present work indicates that of the states in ^{15}N (10.70, 13.1, and 15.5 MeV) which have been proposed as having a large $^{12}C + t$ cluster component, only the 15.5 MeV state has a large cluster component corresponding to $^{11}B + \alpha$. (auth)

31703 PRODUCTION OF HYPERNUCLEI IN A 2.1 GeV/NUCLEON OXYGEN BEAM. Nield, K.J.; Bowen, T.; Cable, G.D.; DeLise, D.A.; Jenkins, E.W.; Kalbach, R.M.; Noggle, R.C.; Pifer, A.E. (Department of Physics, University of Arizona, Tucson, Arizona 85721). Phys. Rev. C 13: No. 3, 1263-1266 (Mar 1976).

The first hypernuclei production experiment using a beam of heavy ions from the Lawrence Berkeley Laboratory Bevatron is described. Mass 16 hypernuclei were produced by 2.1 GeV/nucleon ^{16}O ions incident on a polyethylene target. These relativistic hypernuclei were studied with large gap spark chambers that were electronically triggered by the low momentum K^+ meson produced in association. Analysis of 22 events yields a mean lifetime $\tau\,(^{16}Z_\Lambda) = (0.86^{+0.33}_{-0.26}) \times 10^{-10}$ sec. (auth)

31704 SPECTROSCOPIC UTILITY OF THE TWO-PROTON PICK-UP $(^6Li, ^8B)$ REACTION. Weisenmiller, R.B.; Jelley, N.A.; Wilcox, K.H.; Wozniak, G.J.; Cerny, J. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. C 13: No. 3, 1330-1333 (Mar 1976).

Data for the $(^6Li, ^8B)$ reaction on targets of ^{10}B, ^{12}C, ^{13}C, and ^{16}O at 80 and 93 MeV are presented. Spectroscopic selectivity is observed and evidence for the dominance of spatially symmetric transfer of the two protons is shown. On the $T_z = 0$ targets a close similarity is found to the analogous (p, t) reaction, and the ^{13}C results indicate the location of low-lying $1p$-shell states in ^{11}Be. (auth)

31705 SHORT-RANGE CORRELATIONS WITH PSEUDO-POTENTIALS. I. Osman, A. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim., A; 31A: No. 3, 487-497(1 Feb 1975).

Short-range correlations in nuclei are considered. The nucleon-nucleon interaction is separated into two parts: the short-range part which contributes to the strong repulsive forces between nucleons and the long-range attractive part. To achieve healing in the correlated wave function, a short-range pseudopotential is introduced. This separation is applied for some nucleon-nucleon interactions. The binding energies per particle in the spherical nuclei ^{16}O and ^{40}Ca are presented with this separation for the Hamada–Johnston, the Yale, the Reid potentials and for a nucleon-nucleon potential calculated according to meson exchange between nucleons. (auth)

31706 VARIATIONAL CALCULATION OF CLUSTER STRUCTURE OF THE ^8Be. Steshenko, A. I. (Inst. of Theoretical Physics, Moscow). Yad. Fiz.; 23: No. 1, 44-52(Jan 1976). (In Russian)

The α-cluster structure of the ^8Be nuclei is studied for a number of central exchange nucleon–nucleon potentials. Trial wave functions of separate α clusters are constructed as a superposition of 1s and 1p states of the oscillatory shell model. The characteristics of the mass density distribution and the ground state energy are calculated. A detailed comparison of various characteristics in the cluster and nuclear shell models is made. The overlap integral between the wave functions of the models under consideration is calculated. The obtained results allow one to study the dependence of the nuclear features upon the model assumptions as well as upon the choice of NN potentials.

31707 QUASIELASTIC KNOCK-OUT OF CLUSTERS FROM ATOMIC NUCLEI IN THE MULTIPLE SCATTERING THEORY. Golovanova, N. F.; Il'in, I. M.; Neudachin, V. G.; Smirnov, Yu. F.; Chuvil'skii, Yu. M. (Inst. of Nuclear Physics, Moscow). Yad. Fiz.; 23: No. 1, 64-76(Jan 1976). (In Russian)

A new method is developed to describe quasielastic knock-out of light fragments from atomic nuclei at high energy by using Glauber-Sitenko multiple scattering theory. Taking the reactions $^6Li(p, pt)^3He$, $^{16}O(p, pd)^{14}N$ and $^{16}O(p, p\alpha)^{12}C$ as examples, it is shown that in the region of b-times scattering ($b = 2, 3, 4$) a large number of intrinsic nl states with $n, l \neq 0$ plays an important role. The results essentially differ from those of the previous theoretical calculations made by taking into account only $n = l = 0$ states. (auth)

31708 PHASE-SHIFT MATRIX ELEMENTS AND LEVELS OF LIGHT NUCLEI. Kumar, N. (Indian Inst. of Tech., Kanpur); Soni, S. K. Indian J. Chem.; 13: No. 12, 826-828(Dec 1975).

Shell model calculations, using relative coordinate matrix elements of different workers derived directly from two-nucleon phase-shifts, have been carried out for the nuclei of mass numbers 6 to 9. Matrix elements of D. S. Koltun and of Ley Koo et al. have been found to predict the excitation energies of nuclear levels better than the matrix elements of other workers; and the single-nucleon transfer spectroscopic factors have been found to be predicted equally well by the matrix elements of all the workers. It is pointed out that to obtain good agreement with experimental excitation energies, the strengths of $^3S_1$ matrix elements of some workers need to be enhanced. 1 figure, 3 tables. (auth)

31709 EFFECT OF SHORT RANGE CORRELATIONS IN CHARGED PION PHOTOPRODUCTION FROM ^{16}O. Rao, K. S. (Laval Univ., Quebec City (Canada). Dept. de Physique); Devanathan, V. (Madras Univ. (India). Dept. of Nuclear Physics). Can. J. Phys.; 53: No. 13, 1292-1298(1 Jul 1975).

Short range correlations in nuclei are introduced into the

nuclear wave function using a unitary operator whose form was originally suggested by Villars. Their effect on positive pion photoproduction from ^{14}O is found to be small for the correlation function we have assumed. (auth)

31710 ANGULAR CORRELATION STUDY OF SOME HIGHLY EXCITED LEVELS OF ^{16}O. Avril, M.; Lepareux, M.; Saunier, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique Nucleaire); Foti, A.; Pappalardo, G.; Strazzeri, A. (Istituto Nazionale di Fisica Nucleare, Catania (Italy)). J. Phys. (Paris), Lett.; 36: No. 10, L.229-L.231(Oct 1975).

Angular correlation measurements of 0° involving the reaction $^{12}C(^6Li,d)^{16}O \rightarrow \alpha_0 + ^{12}C_{g.s.}$ have been used to study several highly excited states in ^{16}O, between 20 and 24 MeV. The method has been tested using the known 6^+ at 16.3 MeV. No indications of a 8^+ level was found from detailed analysis around the 20.9 broad peak. The results is in agreement with earlier assignment of 7^- for this level. A spin 6 is assigned to the 21.8 level, observed in (^{6}Li,d) and (^{7}Li,t) data. (FR)

31711 FURTHER COMMENT ON SPURIOUS CENTER-OF-MASS MOTION. McGrory, J. B. (Oak Ridge National Lab., TN); Wildenthal, B. H. Phys. Rev., B; 60: No. 1, 5-8(22 Dec 1975).

Arguments are presented which indicate the Gloeckner-Lawson prescription for eliminating states with spurious center-of-mass motion from highly truncated shell-model calculations is not generally useful. (auth)

31712 $T=2$ STATES IN ^{12}C AND ^{12}B. Ashery, D.; Zisman, M.S.; Goth, G.W.; Wozniak, G.J.; Weisenmiller, R.B.; Cerny, J. (Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). Phys. Rev. C 13: No. 4, 1345-1351 (Apr 1976).

The $^{14}C(p, t)^{12}C$ and $^{14}C(p, ^3He)^{12}B$ reactions have been investigated at $E_p=54$ MeV. The lowest 0^+, $T=2$ state in ^{12}C was identified at 27.57 ± 0.03 MeV and a higher $T=2$ state was found at 29.63 ± 0.05 MeV. Their analogs in ^{12}B were found at 12.72 ± 0.07 and 14.82 ± 0.10 MeV, respectively. In a separate coincidence experiment, the proton and α decay modes of the $T=2$ states in ^{12}C were studied. The 27.57 MeV state decays (30 ± 10) % by proton emission and less than 10% by α emission. The 29.63 MeV state decays by about 80% proton emission and 20% α emission. (auth)

31713 COMPUTING THE FINITE-RANGE DISTORTED-WAVE BORN APPROXIMATION FOR $^{11}B(^{16}O, ^{15}N)^{12}C$. Delic, G. (Lawrence Berkeley Laboratory, Berkeley, California 94720). Phys. Rev. Lett. 36: No. 11, 569-572 (15 Mar 1976).

Two-dimensional quadrature formulas with a minimal number of points are applied to the computation of the double radial integral in the finite-range distorted-wave Born approximation for nuclear reactions. The resulting code KUNDRY is fast, especially in cluster transfer fer reactions where the integrated area is largest. The code was used to investigate the reaction $^{11}B(^{16}O, ^{15}N)^{12}C$ and the coherent interference between the proton and alpha-cluster transfer reaction mechanisms. (auth)

31714 INCLUSIVE CROSS SECTIONS FOR 180° PRODUCTION OF HIGH-ENERGY PROTONS, DEUTERONS, AND TRITONS IN p-NUCLEUS COLLISIONS AT 600 AND 800 MeV. Frankel, S.; Frati, W. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174); Van Dyck, O.; Werbeck, R.; Highland, V. Phys. Rev. Lett. 36: No. 12, 642-645 (22 Mar 1976).

The inclusive cross sections, measured up to large values of effective mass ($\equiv q^2/2\nu$), are well fitted by $d\sigma/d^3p = B_x \exp(-\alpha_x p^2/2m_x)$. Values of B_x and α_x are given for Be, C, Cu, and Ta at the incident proton energy of 600 MeV and for Ag, Ta, and Pt at 800 MeV. Extremely large d/p and t/p ratios and large A and q^2 dependences of the relative cross sections are observed. (auth)

31715 $^{18}O+^{12}C$ SYSTEM: EVIDENCE FOR NONSTATISTICAL INTERMEDIATE STRUCTURE WITH ENHANCEMENT OF ODD PARTIAL WAVES IN THE ELASTIC CHANNEL. Webb, M.P.; Vandenbosch, R.; Eberhard, K.A.; Bernhardt, K.G.; Zisman, M.S. (University of Washington, Seattle, Washington 98195). Phys. Rev. Lett. 36: No. 14, 779-782 (5 Apr 1976).

$^{18}O+^{12}C$ elastic-scattering excitation functions have been measured at eight angles over the energy range 12-25 MeV (c.m.). In addition, cross sections for the reaction channels $^{12}C(^{18}O,\alpha)$ $^{26}Mg(E_x=0.0\text{-}5.47$ MeV) and $^{12}C(^{18}O, ^{16}O)^{14}C$ were measured over nearly the same energy range. The elastic scattering exhibits the novel behavior of being dominated by odd partial waves. Correlated structures were observed at 16.6, 19.0($J^\pi=15^-$), and 21.8($J^\pi=17^-$) MeV (c.m.). (auth)

31716 ANALYSIS OF THE $^{12}C(d, ^3He)^{11}B$(g.s.) REACTION AT 80 MeV. Didelez, J.; Chang, C.C.; Chant, N.S.; Holmgren, H.D.; Steinberg, R.I.; Wu, J.R. (University of Maryland, College Park, Maryland 20742). Phys. Rev. C 13: No. 4, 1388-1391 (Apr 1976).

Distorted-wave Born approximation calculations for the $^{12}C(d, ^3He)^{11}B$(g.s.) reaction at 80 MeV are reported. By using "deep" potentials to generate the exit channel distorted waves, good fits to the data are possible, contrary to previously reported results. Finite range effects are found to be small, reducing the cross sections calculated in zero range approximation by 20 to 25%. It is shown that the usual local energy approximation overestimates finite range effects. (auth)

31717 NUCLEAR SIZE AND BOUNDARY EFFECTS ON THE FUSION BARRIER OF OXYGEN WITH CARBON. Eyal, Y. (Department of Isotope Research, The Weizmann Institute of Science, Rehovot, Israel); Beckerman, M.; Chechik, R.; Fraenkel, Z.; Stocker, H. Phys. Rev. C 13: No. 4, 1527-1535 (Apr 1976).

Absolute yields, energy spectra, and angular distributions of heavy residual nuclei ranging from Ne to Si have been measured in the reactions $^{16}O + ^{12}C$, $^{17}O + ^{12}C$, and $^{18}O + ^{12}C$. For each system measurements have been performed at seven beam energies corresponding to the range 7 to 14 MeV c.m. The formation of the above products is shown to be consistent with a reaction which proceeds through the formation and decay of an excited and equilibrated composite system. Systematic differences between the absolute magnitudes of the fusion cross sections of the three reactions have been observed. It is shown that these differences are closely related to the expected differences in the nuclear size and surface diffuseness of the oxygen isotopes. Possible implications for astrophysical processes are briefly discussed. (auth)

31718 CALCULATION OF ELECTROEXCITATION CROSS SECTIONS IN ^{12}C BY A CONTINUUM SHELL MODEL. Kawazoe, Y.; Tsukamoto, T. (Department of Physics, College of Arts and Sciences, Tohoku University, Sendai, Japan). Phys. Rev. C 13: No. 4, 1759-1761 (Apr 1976).

Electroexcitation of ^{12}C in the giant multipole resonance region is studied using the methods of nuclear reaction theory. The importance of using orthogonalized wave functions for calculations of differential cross sections is pointed out, especially for monopole excitations. (auth)

31719 LIFETIME MEASUREMENTS IN A equals 14 AND 15 NUCLEI. Ruiz, C. L. Lawrence, KS; Univ. of Kansas (1975). 94p. University Microfilms Order No. 76-1299.

Thesis (Ph.D.).

Electromagnetic transition rates of bound levels in ^{14}N, ^{14}C, and ^{15}N nuclei have been studied through lifetime measurements employing the Doppler shift attenuation method. The 4-MeV Van de Graaff accelerator at the University of Kansas was used to provide 1.4 to 2.2 MeV deuteron beams bombarding thin targets of ^{13}C (approximately 10 mu gm/cm^2) and ^{14}C (approximately 6 mu gm/cm^2) backed onto nickel foils (approximately 2 mg/cm^2). The gamma rays emitted from $^{13}C(d,n)^{14}N$, $^{13}C(d,p)^{14}C$, and $^{14}C(d,n)^{15}N$ reactions were observed at 90^0 and 0^0 angular settings with respect to the beam direction by a (60 cc) Ge(Li) detector. The 90^0 data provided centroid information of the unshifted gamma rays. The 0^0 data provided both "vacuum" and "stopped" gamma ray line shapes. The experimental 0^0 line shapes were then compared to computed curves by a non-linear regression method to extract the following mean lifetimes (in fs): ^{14}N(5.691), tau equals 10.0 +- 2.0; ^{14}N(4.913), tau equals 9.0 +- 2.7; ^{14}N(5.106), tau greater than 1.0 ps; ^{14}N(3.945), tau greater than 15; ^{14}N(2.313), tau greater than 40; ^{14}C(6.093), tau equals 13.0 +- 4.0; ^{15}N(9.155), tau equals 8.2 +- 1.5; ^{15}N(9.152), tau equals 10.0 +- 4.2; ^{15}N(9.053), tau equals 6.2 +- 1.3; ^{15}N(8.313), tau equals 7.6 +- 2.2; ^{15}N(8.576), tau equals 6.6 +- 2.0; ^{15}N(7.301), tau equals 19.5 +- 7.4; ^{15}N(7.155), tau equals 15.0 +- 7.0; ^{15}N(6.324), tau equals 23.7 +- 5.0. A comparison is made between these results and current shell model predictions of some lifetimes pertaining to ^{14}N, ^{14}C, and ^{15}N. Further conclusions are drawn from systematic behavior of electromagnetic transition rates in light nuclei (A less than 40). (Diss. Abstr. Int., B)

31720 RADIATIVE WIDTHS OF THE 16.6 TO 16.9 MeV DOUBLET IN ^8Be. Nathan, A. M. Princeton, NJ; Princeton Univ. (1975). 207p. University Microfilms Order No. 76-261.

Thesis (Ph.D.).

The isovector M1 decay rates of the 16.6-16.9 MeV 2+ doublet in ^8Be to the 2.9 MeV 2+ first excited state have been measured. The total rate summed over both levels is found to be GAMMA/sub m1/ equals 4.94 +- 0.80 eV. This allows a determination of the weak magnetism form factor b which is proportional to GAMMA/sub m1//sup 1/2/. If this result is compared with the result of a recent beta-alpha angular correlation measurement in the beta decays of the analogue 8 Li and 8B ground states to the same final state, a model independent test of the Conserved Vector Current theory is possible. It is shown that the existing data are consistent with both CVC and the nonexistence of a 2nd class induced tensor form factor. (Diss. Abstr. Int., B)

31721 INTERACTION OF PIONS WITH SELF-CONJUGATE EVEN-EVEN NUCLEI NEAR THE (3,3) RESONANCE. Youssef,

N. N. Logan, UT; Utah State Univ. (1973). 85p. University Microfilms Order No. 75-14,479.

Thesis (Ph. D.).

In this work an investigation is made of the role which might be played by DELTA N final state interactions in the process ^{12}C(pi/sup +/-/,pi N)^{11}C. Studies of pion absorption by nuclei are reviewed and evidence is presented for strong two particle np correlations which predominate over the corresponding nn and pp correlations. A study is also made of systematic evidences for 3 and 4 particle correlations from nuclear binding energies. The DELTA N interaction is investigated assuming a direct potential with one pion exchange and calculations are made for the DELTA-N system which illustrate the expectation of strong DELTA N interactions. Experimental results for the cross section ratio R equals sigma(pi$^-$ + ^{12}C yields pi$^-$ + n + ^{11}C)/(sigma(pi$^+$ + ^{12}C yields pi$^+$ + n + ^{11}C) + sigma(pi$^+$ + ^{12}C yields pi^0 + p + ^{11}C)) for self conjugate even-even light nuclei and previous theoretical attempts to account for the measured ratio R equals 1 are discussed. A mechanism is proposed in which DELTA N rescattering plays an important role. The mechanism depends strongly on the strength of the 2 particle np correlations and the DELTA N interaction previously discussed. It is shown that it is possible for this mechanism to account for the observed experimental ratio. (Diss. Abstr. Int., B)

31722 QUASI-ELASTIC (alpha, 2 alpha) REACTION AT 700 MeV ON SEVERAL LIGHT AND MEDIUM NUCLEI. Dollhopf, W. E. Williamsburg, VA; College of William and Mary (1975). 199p. University Microfilms Order No. 76-721.

Thesis (Ph. D.).

The quasi-elastic (alpha, 2 alpha) differential cross-section at 700 MeV was measured as a function of recoil momentum for targets of ^{6}Li, ^{10}B, ^{12}C, ^{16}O, ^{23}Na, ^{27}Al, Fe, and Cu. A Pb target was also studied, but a cross-section could not be extracted from the data. The 700 MeV alpha particles were incident upon a given target which was viewed by two charged particle telescopes. The telescopes were oriented at 35^0/52.5^0 to detect the quasi-elastically scattered alphas in coincidence. The scattering angles of both particles were measured along with either their momentum or energy. Particle identification was accomplished by a measurement of the magnetic rigidity B rho and the TOF to determine the invariant mass on the 35^0 side and by a combination of range - dE/dx information on the 52.5^0 side. The measured recoil momentum distribution extracted from the differential cross-section data was found to be consistent in all cases with a Lorentzian function, the Fourier transform of the asymptotic part of the radial wave function. The vertex constants describing the virtual transition of the target nucleus into an alpha cluster and a core cluster were found to be consistent with the same value of 3.6 x 10^{-3} (MeV/c)/sup 1/2/ for each of the targets studied. Values for the effective clustering in each of these targets were also determined. The recoil momentum distribution obtained from the ^{6}Li target has been found to be in excellent agreement with other quasi-elastic experiments at energies above 150 MeV. For monitoring purposes, the cross-section for the reaction ^{12}C(alpha,alpha n)^{11}C was determined by measuring the induced ^{11}C-activity. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 30827, 31458, 31666, 31667, 31682, 31683, 31685–31687, 31695, 31699, 31722, 31732, 31766, 31767, 31816, 31903, and 31916.

31723 (CEA-CONF-3294) FIRST LEVELS OF ^{32}S IN THE ^{31}P(d,n)^{32}S REACTION. Uzureau, J.; Adam, A.; Bersillon, O. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 11p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

The angular distributions of first neutron groups from the ^{31}P(d,n)^{32}S reaction have been measured at E_d = 7 MeV with a time-of-flight spectrometer. The experimental cross sections are analysed in the framework of the DWBA and Hauser–Feshbach theories to deduce l_p values and transition strengths. These transition strengths are compared with those from other experiments and with shell-model calculations. (FR)

31724 (CEA-CONF-3304) ANALYSIS OF THE EXPERIMENTAL DATA ON CARBON-NEUTRON INTERACTIONS FOR ENERGY BELOW 20 MeV. Haouat, G.; Lachkar, J.; Patin, Y.; Sigaud, J.; Cocu, F. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 19p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

An evaluation of the neutron-induced cross sections of carbon has been completed for the energy region 10^{-4} eV to 20 MeV. The recommended data are based on experiments, some of them being done in this laboratory. Energy and angular distributions of secondary neutrons and photons are included. The adopted values are discussed. (FR)

31725 (IAEA-R-926-F) SYSTEMATIC STUDY OF GAMMA RAYS FROM 14 MeV BOMBARDMENT OF NUCLEI. Final Report for the Period 1 July 1970–31 May 1974. Cindro, N. (International Atomic Energy Agency, Vienna (Austria)). Dec 1974. 10p. INIS.

Neutron capture (n, γ) cross sections at 14.4 MeV were determined by the activation method for the isotopes ^{27}Mg, ^{37}Cl, ^{50}Ti, ^{55}Mn, ^{75}As, ^{127}I, ^{138}Ba, ^{141}Pr, and ^{170}Er. Absolute cross sections were calculated by comparison with the ^{27}(n, α)^{24}Na and ^{56}Fe (n, p) ^{56}Mn cross sections at 14.4 MeV which were taken to be 114 ± mb and 100 ± 6mb, respectively. The results were (in mb): 0.54 ± 0.2, 1.0 ± 0.3, 0.7 ± 0.2, 0.8 ± 0.1, 1.7 ± 0.3, 1.2 ± 0.1, 0.7 ± 0.1, 2.7 ± 0.5, 1.7 ± 0.5. The residual activity was measured using a 30 cm^3 Ge-Li detector. The production of contaminating lower energy secondary neutrons was considerably reduced by employing an aluminium rather than a brass target holder. Good agreement was found between these cross section measurements and those made by the integration technique (whereby the high energy prompt gammas are counted), in contrast to some previous results. The present cross sections are found to agree best with the semi-direct theory.

31726 (INIS-mf-1891, pp 44-77) THE STATISTICAL MODEL OF NUCLEAR REACTIONS AS A SPECTROSCOPICAL TOOL. Chapter 3. Hasper, H. 6 Dec 1974.

Chapter 1 of this thesis has been published in Atomindex under 030498.

In nuclear structure studies on ^{38}K. (Rijksuniversiteit Groningen (Netherlands)).

Results are presented of a comparison between average yields to levels in ^{38}K populated in the ^{40}Ca(d,α) reaction, and Hauser–Feshbach calculations. Fluctuation analysis was also carried out on the yield curves. This provided an objective basis for the assignment of errors to the average yields. The conclusion is reached that this type of comparison can be a useful supplementary tool in spin-parity assignment.

31727 (INIS-mf-1891, pp 78-115) SHELL-MODEL CALCULATIONS ON EVEN AND ODD-PARITY STATES IN UPPER sd-SHELL NUCLEI. Chapter 4. Hasper, H. 6 Dec 1974.

Chapter 1 of this thesis has been published in Atomindex under 030498.

In nuclear structure studies on ^{38}K. (Rijksuniversiteit Groningen (Netherlands)).

The results of shell-model calculations for even-parity states in nuclei with mass number A = 35 through 39 and for odd-parity states in nuclei with mass number A = 36 through 39 are presented. For the positive-parity states, two different residual interactions were used: the MSDI and the MSDI + TENSOR interaction. For positive-parity states, three model spaces were tried: the ($1d_{\frac{5}{2}}$,$2s_{\frac{1}{2}}$,$1d_{\frac{3}{2}}$) configuration, the ($2s_{\frac{1}{2}}$,$1d_{\frac{3}{2}}$,$1f_{\frac{7}{2}}$) configuration and a truncated ($2s_{\frac{1}{2}}$,$1d_{\frac{3}{2}}$,$1f_{\frac{7}{2}}$,$2p_{\frac{3}{2}}$) configuration. Only this last model space was used for calculations of negative-parity states. Calculated and experimental level schemes are compared. Lifetimes, branchings and log ft values are calculated and compared with experimental data for some positive-parity states in ^{38}K. The conclusion is justified that the addition of a tensor force brings about a significant improvement in the calculations. Further it is clear that the extension of the configuration to the fp shell explains a number of "intruder" states for A as low as 36.

31728 (INIS-mf-1925) STUDY OF ^{20}Ne EXCITED STATES WITH THE TAMM-DANCOFF APPROXIMATION. Mizrahi, S. S. (Sao Paulo Univ. (Brazil). Instituto de Fisica). 1972. 71p. (In Portuguese). INIS.

Using the Hartree–Fock theory, the wave function which describes the ^{20}Ne nucleus in its fundamental state is calculated. The Tamm–Dancoff wave function is constructed, to the first order, which describes the excited states of the nucleus, promoting a nucleon to an unoccupied state from the Hartree–Fock base. The Tamm–Dancoff wave function will be a linear combination of states of 1 particle – 1 hole. The Peierls–Yoccoz projection method is used to obtain wave functions with total angular momentum well defined. Using these functions, the energy of the states of the lowest excited band is calculated, as well as the reduced transition probabilities B (E2), interband and intraband. Finally, a comparison is made of these results with the experimental data and with theoretical results obtained by other authors.

31729 (INIS-mf-1937, pp 24-37) TRANSIENT FIELD MEASUREMENTS OF G-FACTORS FOR ^{28}Si AND ^{30}Si, CH. 2. Eberhardt, J. L. 16 Jun 1975.

Thesis.

In magnetic moment measurements on very short-lived nuclear states in Megagauss transient magnetic fields. (Rijksuniversiteit Utrecht (Netherlands)).

Transient field precession measurements have been performed on the first excited $J^\pi = 2^+$ states of ^{28}Si and ^{30}Si with the IMPAC technique on recoil in magnetized iron. The results were analyzed with empirically admusted Lindhard–Winther predictions. This yields g-factors of $g = +0.56 \pm 0.09$ and $g = +0.56 \pm 0.16$ for ^{28}Si and ^{30}Si respectively. In the present cases the influence of static hyperfine fields is negligible due to the very short mean lives for ^{28}Si and ^{30}Si or 0.68 and 0.35 ps, respectively. The results are compared with the more recent lifetime of $\tau_m = 0.72 \pm 0.03$ ps. The value of the g-factor becomes $g = +0.82 \pm 0.16$.

31730 ABOUT PRE-EQUILIBRIUM EMISSION IN (n,p) REACTION ON LIGHT NUCLEI. Aleksandrov, D. V.; Klochkova, L. I.; Kovrigin, B. S. (Leningrad Technological Inst.). Yad. Fiz.; 22: No. 6, 1146-1149(Dec 1975). (In Russian).

Proton energy spectra of the (n,p) reaction on nuclei ^{27}Al, ^{28}Si, ^{31}P, ^{35}Cl, ^{39}K, and ^{52}Cr are investigated to detect a presence of protons from pre-equilibrium emission. It is found that the experimental proton spectra are reasonably described by calculations based on the theory of pre-equilibrium emission as well as on the statistical theory. Such a similarity between the pre-equilibrium emission spectra and the evaporation spectra may be explained by decrease of the differences between two processes in case of comparatively light nuclei. (auth)

31731 ^{21}Na STATES BETWEEN E_x = 5.5 AND 6.2 MeV. Drain, D.; Chambon, B.; Chanut, Y.; Desgrolard, P. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire; Institut National de Physique Nucleaire et de Physique des Particules, 69–Villeurbanne (France)). Z. Phys., A; 274: No. 4, 353-358 (Oct 1975).

4 figs.; 2 tabs.; 17 refs.

States in ^{21}Na between 5.5 and 6.2 MeV have been investigated by means of the ^{20}Ne(p,p)^{20}Ne, ^{20}Ne(p,p′)^{20}Ne and ^{20}Ne(p,p′γ)^{20}Ne reactions. The gas target is Ne in naturally occurring abundances or enriched to 99.9% in ^{20}Ne. No new levels were seen but a new value of the spin of the 5.814 MeV state is given: $J^\pi = 7/2^-$. The $J^\pi = (5/2, 7/2)^-$ assignment of the 6.076 MeV level is confirmed. (DE)

31732 RESONANCE SPECTROSCOPY OF ^{30}Si NUCLEUS IN THE EXCITATION ENERGY RANGE 14.27 TO 15.02 MeV. Namjoshi, L.V.; Gupta, S.K.; Mehta, M.K.; Kerekatte, S.S. (Van de Graaff Laboratory, Nuclear Physics Division, Bhabha Atomic Research Centre, Bombay 400 085, India). Phys. Rev. C 13: No. 3, 915-921 (Mar 1976).

Absolute differential cross sections for the elastic scattering of α particles from ^{26}Mg have been measured as a function of bombarding energy between 4.18 and 5.14 MeV at angles corresponding to the c.m. angles 90°, 125°, 141°, and 167°. The data have been analyzed using the multilevel multichannel expression of R matrix theory modified to replace the background hard sphere phase shifts by complex optical model phase shifts. These phase shifts have been obtained by fitting the averaged cross section with the optical model. This modification has resulted in reasonably good fits to excitation functions both in magnitude and shape. Twelve levels in the compound nucleus ^{30}Si have been identified and their spins, parities, and widths have been determined. The possibility of the 0^+ levels being fragmented components of a quartet parent state has been discussed. (auth)

31733 BACK-ANGLE ^{3}He AND α-PARTICLE ELASTIC SCATTERING FROM ^{27}Al. Fulmer, C.B.; Hensley, D.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Hafele, J.C.; Foster, C.C.; O'Fallon, N.M.; Eidson, W.W.; Gronemeyer, S.A. Phys. Rev. C 13: No. 3, 937-943 (Mar 1976).

Back-angle elastic scattering measurements were performed for ^{3}He and α particles on ^{27}Al targets. Data were obtained at 11 energies between 14 and 31 MeV for ^{3}He particles and at 15 energies between 13 and 40 MeV for α particles. 180° elastic cross sections for α particles are a factor of ~100 larger than those for ^{3}He particles of the same energy. The α-particle angular distributions all peak at 180°, whereas mimina at 180° are observed in some of the ^{3}He angular distributions. A number of optical-model analyses were performed on the data, and the results of the analyses show a pronounced energy dependence of the absorption term of the potential for α particles but not for ^{3}He particles. (auth)

31734 GAMMA-EMITTING STATES IN ^{22}Ne. Broude, C.; Davies, W.G.; Forster, J.S.; Ball, G.C. (Atomic Energy of Canada Limited, Physics Division, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada KOJ 1JO). Phys. Rev. C 13: No. 3, 953-966 (Mar 1976).

Thirty-seven γ-emitting levels have been observed in ^{22}Ne up to an excitation energy of 11.48 MeV following the reaction ^{19}F(α, pγ)^{22}Ne at E_α=20.0 MeV. The decay modes and particle-γ correlations of 22 of these levels have been measured. Seven levels of spin 5 or greater have been observed above 8.7 MeV excitation. Extensive collective band structure consistent with the available experimental evidence is proposed. (auth)

31735 EXCITATION FUNCTIONS OF REACTIONS INDUCED BY ^{1}H AND ^{2}H IONS ON NATURAL Mg, Al, AND Si. Wilson, R.L. (Department of Physics and Astronomy, University of Wyoming, Laremie, Wyoming 82071); Détraz, C.; Frantsvog, D.J.; Kunselman, A.R.; Zaidins, C.S. Phys. Rev. C 13: No. 3, 976-983 (Mar 1976).

Cross sections for various reactions induced by beams of ^{1}H and ^{2}H ions on targets of natural Mg, Al, and Si were determined from observations of the radioactive product γ rays. ^{1}H energies between 14.5 and 27.0 MeV and ^{2}H energies between 8.7 and 18.0 MeV from the University of Colorado cyclotron were used. (auth)

31736 ELECTROMAGNETIC PROPERTIES OF THE 6621- AND 7950-keV LEVELS IN ^{32}S. Vernotte, J.; Maison, J.M. (Institut de Physique Nucléaire, B. P. No. 1, 91406-Orsay, France); Chevallier, A.; Huck, A.; Miehe, C.; Walter, G. Phys. Rev. C 13: No. 3, 984-993 (Mar 1976).

Lifetime and γ-ray angular distribution measurements have been carried out at the 1247-, 1399-, 1402-, 1437-, and 1581-keV resonances of the ^{31}P(p,γ)^{32}S reaction. Mean lifetime values have been measured for the 5006-, 5413-, 6224-, 6621-, and 7950-keV levels. The J^π value of the 7950-keV level has been determined as $J^\pi = 4^-$. The strengths of some isoscalar $M2$ transitions were measured. Electromagnetic features of the 6621-keV level are discussed in the framework of the vibrational model. (auth)

31737 HEAVY-ION FUSION-EVAPORATION REACTIONS: HIGH SPIN STATES IN ^{43}Ca AND ^{43}Sc. Poletti, A.R. (University of Auckland, Auckland, New Zealand); Warburton, E.K.; Olness, J.W.; Kolata, J.J.; Gorodetzky, P. Phys. Rev. C 13: No. 3, 1180-1193 (Mar 1976).

Fusion-evaporation reactions, primarily ^{27}Al(^{19}F, $n2p$)^{43}Ca and ^{27}Al(^{19}F, $2np$)^{43}Sc, have been used to investigate the structure and formation of the residual nuclei. Decay schemes of the yrast levels which are populated are presented together with suggested spin assignments for some of the higher levels: Incidental results obtained for the nuclei ^{44}Ca, ^{44}Sc, and ^{40}Ca are also discussed. Mean lifetimes measured by the recoil distance method are as follows: (^{43}Ca): 2754-keV level, τ = 34.1 ± 1.5 psec; 990-keV level, τ = 73 ± 11 psec; (^{43}Sc): 880-keV level, τ = 7.0 ± 1.4 psec; 472-keV level, τ = 233 ± 53 psec; (^{44}Ca): 3285-keV level, τ = 23 ± 7 psec, 2283-keV level, τ < 25 psec; (^{44}Sc): 631-keV level, τ = 550 ± 80 psec; 3567-keV level, τ = 51 ± 10 psec. The properties of the high spin states populated in the ^{19}F + ^{27}Al fusion-evaporation reaction are discussed. Relative excitation intensities of the residual nuclei are interpreted in terms of a Hauser-Feshbach calculation, while a simplified pairing force model allows us to explain a number of observations in specific nuclei. (auth)

31738 INTERNAL BREMSSTRAHLUNG SPECTRA FROM ^{185}W AND ^{32}P. Babu, R.P.; Murty, K.N.; Murty, V.A.N. (Laboratories for Nuclear Research, Andhra University, Visakhapatnam-530003, India). Phys. Rev. C 13: No. 3, 1267-1276 (Mar 1976).

The internal bremsstrahlung spectra from the β decay of ^{185}W and ^{32}P were measured using a NaI(Tl) scintillation spectrometer with a standard geometrical arrangement. After making all the necessary corrections the experimental results are compared with the allowed theory of the Knipp, Uhlenbeck, and Bloch (KUB theory) and also with the Coulomb corrected theories of Lewis, Ford, and Nilsson. In the case of ^{185}W it is found that from 78 to 200 keV the experimental distribution is in good agreement with the KUB theory whereas beyond 200 keV and below 78 keV the experimental points are far above even the highest Coulomb corrected theoretical distribution of Nilsson. The internal bremsstrahlung from this isotope has not been previously investigated. In the case of ^{32}P the experimental relative intensity spectrum is compared with the KUB theory and also with the Coulomb corrected theory of Lewis and Ford. Fairly good agreement is obtained from 30 to 200 keV with the KUB theory but in the energy region from 200 to 900 keV, the experimental results deviate positively from both the KUB and Lewis and Ford theories. The experimental excess over the Lewis and Ford theory is 15% on the average. (auth)

31739 ^{34}S(p, t)^{32}S REACTION. Nann, H.; Wildenthal, B.H. (Cyclotron Laboratory and Department of Physics, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 13: No. 3, 1009-1017 (Mar 1976).

Angular distributions of the ^{34}S(p,t)^{32}S reaction at E_p=40 MeV have been measured for states in ^{32}S up to an excitation energy of 11 MeV. Assignments of the L transfers on the basis of the characteristic shapes of the angular distributions yield several new spin and parity assignments for states in ^{32}S. Transitions to several unnatural parity states in ^{32}S were observed with a cross section of about 5 μb/sr. For

transitions to the natural parity states distorted-wave analyses based on current shell-model wave functions were performed and compared to the experimental differential cross sections. (auth)

31740 PHOTON YIELD AND ENERGY IN INTERNAL BREMSSTRAHLUNG. Powar, M. S.; Singh, M. (Punjabi Univ., India). Curr. Sci. (India); 45: No. 4, 131-133(20 Feb 1976).

Measurements of photon yield and internal bremsstrahlung energy are reported for ^{32}P, ^{35}S, ^{45}Ca, ^{90}Y, and ^{204}Tl and compared with several theoretical results. The experimental values were consistently higher than the theoretical ones. (1 table) (RWR)

31741 ANGULAR CORRELATION STUDIES IN ^{27}Al. Haupt, P.; Koen, J. W.; Naude, W. J. (Stellenbosch Univ. (South Africa). Merensky Instituut vir Fisika). Tydskr. Natuurwet.; 14: No. 4, 115-119(Dec 1974).

The applicability of the angular correlation technique method II of Litherland and Ferguson has been studied with a reaction which leads to the population of substates with relatively large magnetic quantum numbers. The decay of the 2,732 MeV level in ^{27}Al, following the reaction $^{27}Al(p,p)^{27}Al$ to this state, is investigated.

31742 ^{7}Li INDUCED SINGLE NUCLEON TRANSFER REACTIONS ON ^{24}Mg AND THE (^{6}Li,alpha) REACTION ON ^{16}O. Moore, G. E. Tallahassee; Florida State Univ. (1975). 215p. University Microfilms Order No. 76-2683.

Thesis (Ph. D.).

Angular distributions for the single-nucleon transfer reactions $^{24}Mg(^{7}Li,^{6}Li)^{25}Mg$ and $^{24}Mg(^{7}Li,^{6}He)^{25}Al$ have been measured at E(^{7}Li) equals 34 MeV to study the effects of target deformation on heavy-ion transfer reactions. Elastic and inelastic scattering angular distributions have also been measured for $^{7}Li + ^{24}Mg$ at the same energy. Optical model fits to the elastic scattering data were good in the diffraction region, but they overestimate the cross section at forward angles. Coupled channels calculations, which coupled the ground and first excited states of ^{24}Mg and ^{7}Li in its ground state, yielded deformation lengths that are in agreement with those obtained from light-ion scattering measurements. The single-nucleon transfer data were compared to exact finite-range distorted-wave Born-approximation (FRDWBA) calculations. Fifty-four-point angular distributions in the angular range 2.5° to 170° have also been measured for the $^{16}O(^{6}Li,alpha)^{18}F$ reaction to states in ^{18}F at a bombarding energy of 34 MeV. The angular distributions for all of the above states are forward peaked and have little structure at back angles. A zero-range normalization factor of 100 is obtained assuming the 5+ state to be pure (d/sub 5/2/)^2 configuration. Finite-range DWBA calculations do not improve the fits to the data and are similar to zero range calculations at forward angles. The 2S and 1D components of ^{6}Li are included in finite range calculations. Shell model wave functions for ^{18}F calculated by Kuo and Brown predict the absolute magnitude of the cross sections to within a factor of two when used in the FRDWBA calculations. Two-particle and cluster form factors used in both zero-range and finite-range calculations gave equivalent fits to the data. Anomalies in the DWBA fits to angular distributions could possibly be explained by a more complete description of the reaction mechanism which includes the exchange of an alpha particle in ^{16}O with the ^{6}Li projectile. (Diss. Abstr. Int., B)

31743 NEUTRON AND GAMMA WIDTHS OF A $J=3/2^-$ DOORWAY STATE IN ^{29}Si. Halderson, D.; Castel, B.; Johnstone, I.P. (Physics Department, Queen's University, Kingston, Ontario, Canada K7L 3N6); Divadeenam, M. Phys. Rev. Lett. 36: No. 13, 760-762 (29 Mar 1976).

The recent experimental evidence for a $J=3/2^-$ doorway state common to the $^{28}Si+n$ and $^{29}Si+\gamma$ channels near 750 keV is found to be supported by a doorway-type calculation, which reproduces neutron and γ widths, as well as the $p_{3/2}$ low-lying spectroscopic strength. The limitations of valence-model calculations reported in literature for ^{29}Si is discussed. (auth)

31744 MULTISTEP INELASTIC PROCESSES IN THE REACTION $^{28}Si(^{3}He, d)^{29}P$ LEADING TO BOUND AND UNBOUND STATES. Ray, L.; Coker, W.R. (Department of Physics, University of Texas, Austin, Texas 78712). Phys. Rev. C 13: No. 4, 1367-1375 (Apr 1976).

We analyze the stripping reaction $^{28}Si(^{3}He, d)^{29}P$ at an incident ^{3}He energy of 35.3 MeV, considering seven residual states. These extend in excitation energy to 4.8 MeV with the highest four being unbound to proton emission and described via complex energy eigenstates. The results of a distorted-wave Born-approximation analysis are rather disappointing. Through a coupled-channel Born approximation analysis, inelastic excitation in both the entrance and exit channels is shown in several cases to be important in accounting for the detailed shape of the angular distributions. Additional data obtained at 20 and 40 MeV are included in the analysis as a check of the optical potentials and spectroscopic amplitudes adopted. The spectroscopic amplitudes used are consistent with results of large-basis shell-model calculations. Good fits to the (^{3}He, *d*) data are obtained in both shape and magnitude, suggesting that the coupled-channel Born approximation should replace the distorted-wave Born approximation in the analysis of experimental data for single-nucleon transfer reactions in this mass region. (auth)

31745 STUDY OF PROPOSED ^{27}Al MODELS BY AN ANALYSIS OF INELASTIC SCATTERING DATA OF 60 TO 90 MeV DEUTERONS. Knöpfle, K.T.; Kiss, A.; Rogge, M.; Schwinn, U.; Turek, P.; Aspelund, O. (Institut für Kernphysik, Kernforschungsanlage Jülich, D-5170 Jülich, West Germany); Mayer-Böricke, C. Phys. Rev. C 13: No. 4, 1400-1405 (Apr 1976).

Angular distributions for elastic and inelastic deuteron scattering on ^{27}Al were measured at E_d=60, 77, and 90 MeV. The data are analyzed by coupled channels calculations and discussed in terms of the weak coupling, strong coupling, and rotational-vibrational models for ^{27}Al. The analysis supports the concepts of rotational-vibrational interaction in ^{27}Al and suggests the level observed at E_x=5.5 MeV to be the third $9/2^+$ member of the $K=5/2$ ground state band. (auth)

31746 ANGULAR CORRELATION AND LIFETIME MEASUREMENTS IN ^{22}Ne. Fifield, L.K.; Zurmühle, R.W.; Balamuth, D.P.; Tabor, S.L. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 13: No. 4, 1515-1526 (Apr 1976).

Particle-γ angular correlations have been measured for a number of states above 7.3 MeV in ^{22}Ne using the $^{18}O(^{7}Li, t\gamma)^{22}Ne$ reaction with the tritons observed at 0°. New information on the spins and parities of several states in ^{22}Ne was obtained. In addition, by demonstrating that the ^{22}Ne nuclei were strongly aligned, these measurements provide support for a direct α-particle transfer mechanism for the $^{18}O(^{7}Li, t)^{22}Ne$ reaction. Angular correlation and lifetime measurements employing the $^{19}F(\alpha, p\gamma)^{22}Ne$ reaction have also been performed for a number of states in ^{22}Ne, including several closely spaced doublets on which previous information is incomplete or inconsistent. Lifetimes were measured by the Doppler-shift attenuation method. The results are compared with recent large basis shell model calculations. (auth)

31747 ELECTRON SCATTERING FROM ^{36}Ar AND ^{40}Ar. Finn, J. M. Washington, DC; Catholic Univ. of America (1975). 190p. University Microfilms Order No. 76-1176.

Thesis (Ph. D.).

The argon isotopes, ^{36}Ar and ^{40}Ar, have been investigated using electron scattering at the high-resolution Linac facilities of the National Bureau of Standards. Both elastic scattering and scattering to low-lying states have been observed. A high-pressure, low-volume gas target cell was designed and developed for this experiment. The cell features a transmission geometry and has resolution comparable to solid targets. Spectra were obtained at incident beam energies ranging from 65 to 115 MeV at scattering angles of 92.5° and 110°. Values obtained for the rms charge radii are 3.327 ± 0.015 and 3.393 ± 0.015 fm for ^{36}Ar and ^{40}Ar respectively. A sensitive measurement was made of the difference in the two radii yielding a value of DELTA r equals 0.079 ± 0.006 fm. The inelastic levels observed are the 1.97 (2^+) and 4.18 MeV (3^-) levels in ^{36}Ar, and the 1.46 (2^+), 2.52 (2^+), 3.21 (2^+), and 3.68 MeV (3^-) levels in ^{40}Ar. A Tassie model analysis was made of the inelastic transitions in the DWBA approximation and transition strengths of these levels were extracted. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 31666, 31667, 31682, 31685, 31687, 31693, 31699, 31705, 31725, 31727, 31730, 31737, 31740, 31747, 31776, and 31916.

31748 (CEA-CONF-3297) CALCULATION OF CROSS SECTIONS OF DISCRETE γ RAYS PRODUCTION IN THE (n,n'γ) REACTION ON CHROMIUM AND NICKEL WITH NEUTRON ENERGY UP TO 10 MeV. Duchemin, B. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 9p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

Cross-sections for the production of de-excitation γ rays following inelastic neutron scattering have been calculated, using the statistical model, and are given for natural chromium and nickel for neutron incident energy up to 10 MeV. (FR)

31749 (CEA-CONF-3311) (n,2n) AND (n,3n) CROSS SECTION MEASUREMENTS FROM THE THRESHOLD UP TO 15 MeV USING THE LARGE Gd-LOADED LIQUID SCINTILLATOR. Fre-

haut, J.; Mosinski, G. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 16p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

The (n,2n) cross sections for ^{45}Sc, ^{56}Fe, ^{59}Co, ^{76}Se, ^{78}Se, ^{80}Se, ^{82}Se, ^{89}Y, ^{93}Nb, ^{103}Rh, ^{169}Tm, ^{175}Lu, ^{181}Ta, ^{197}Au, ^{209}Bi, ^{238}U, and for the natural elements Ga, Pt, W, and the (n,3n) cross section for ^{238}U have been measured from the threshold up to 15 MeV incident neutron energy, using the large Gd-loaded liquid scintillator method and the 14 MeV tandem Van de Graaff accelerator of Bruyeres-le-Chatel as a pulsed neutron source. The (n,2n) and (n,3n) cross sections have been normalized to the fission cross section of ^{238}U and are obtained with a relative accuracy of 5% to 10%. (FR)

31750 (ORO-4856-46) PROJECTION OPERATOR TREATMENT OF SINGLE PARTICLE RESONANCES. Lev, A.; Beres, W. P. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jan 1976. 13p. Dep. NTIS $3.50.

A projection operator method is used to obtain the energy and width of a single particle resonance. The resonance energy is found without scanning. An example of the first g/sub 9/2/ neutron resonance in ^{40}Ca is given and compared with the traditional phase shift method. The results of both approaches are quite similar. 4 figures. (auth)

31751 THE γ ENERGY OF THE ISOMERIC TRANSITION OF CHLORINE-38 m. Grundei, B.; Kreiner, H. J. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Forschungsreaktor; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Forschungsreaktor). Radiochim. Acta; 21: No. 3/4, 214 (1974).

1 fig.; 8 refs.

The half-life was found to be 0.77 ± 0.05 s, the γ energy 671.33 ± 0.2 keV and the neutron activation cross section 47 ± 10 mb. (DE)

31752 OBSERVATION OF A FISSION-LIKE PROCESS IN THE BOMBARDMENT OF ^{48}Ti AND ^{50}Ti BY ^{32}S. Barrette, J.; Braun-Munzinger, P.; Gelbke, C. K.; Grosse, E.; Harney, H. L.; Kuzminski, J.; Tserruya, I.; Walcher, T. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Z. Phys., A; 274: No. 2, 121-125(1975).

6 figs.; 1 tab.; 22 refs.

Heavy reaction products (A ≥ 38) were studied in the bombardment of ^{48,50}Ti by ^{32}S at 105, 130 and 144 MeV beam energies. At 130 and 144 MeV, fragments are observed which have angular and kinetic energy distributions consistent with those expected from fission of the composite system (A ~ 80). (DE)

31753 PAIRING CORRELATIONS AND TWO-NUCLEON TRANSFER REACTIONS ON NUCLEI WITH A = 46 TO 64. Dzholos, R. V.; Kartavenko, V. G.; Semenov, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 6, 1121-1128(Dec 1975). (In Russian).

The data on two-nucleon transfer reactions cross sections are analyzed in the framework of the model constructed to describe collective "pairing" excitations. The differential cross sections of the ^{46}Ca to ^{62}Ni(t, p) reactions are calculated. The influence of anharmonical effects on the spectroscopic factors and reaction cross sections is studied. The results are compared with rotational, vibrational and shell model calculations. (auth)

31754 EFFECT OF THE NUCLEAR CHARGE DENSITY OSCILLATIONS IN ELASTIC SCATTERING OF ELECTRONS. Burov, V. V.; Ivanyuk, F. A.; Konstantinov, B. D. (Inst. of Nuclear Research, Kharkov). Yad. Fiz.; 22: No. 6, 1142-1145(Dec 1975). (In Russian).

The form factors of elastic scattering of electrons by spherical nuclei are calculated in the high energy approximation. The oscillating part of the nuclear charge density distribution (CDD) was calculated in the framework of Strutinsky method of shell corrections. It is shown that the variation of the form factor caused by the CDD oscillating part increases with the increase of the momentum transfer and in the large momentum transfer region reaches the value necessary to fit the data. (auth)

31755 M1 STRENGTH DISTRIBUTION IN NUCLEI. Lipparini, E. (Libera Univ., Trento, Italy); Leonardi, R. Nuovo Cim., A; 31A: No. 2, 207-230(21 Jan 1976).

The M1-transitions in nuclei are studied by means of sum rules. A useful sum rule for the total strength of the M1-excitations is given in terms of the number of the nucleons which are in the nonfilled l-shell. The well known Kurath sum rule for the energy-weighted total strength is generalized to include the two-body potential contribution. The centroid of the excitation is studied; finally the isotopic spreading of the T upper and T lower component of the excitation is analyzed and the "symmetry energy" for the M1-transitions is studied. Not only the centroid shift, but also the isotopic splitting is an effect due to SU_4-breaking terms of the nuclear Hamiltonian, in particular the spin–orbit, Bartlett, Heisenberg terms.

31756 APPLICATION OF SHELL MODEL WITH THE MODIFIED SURFACE DELTA INTERACTION TO ^{42}Ca WITH ^{42}Sc NUCLEI. Jasielska, A.; Wiktor, S. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol., Ser. B; B7: No. 2, 133-140(Feb 1976).

The shell model with MSDI residual interaction is used to investigate properties of levels in the ^{42}Ca and ^{42}Sc nuclei. The ^{40}Ca core with two active outer nucleons is assumed. The interaction between two outer nucleons is given. The numerical values of 196 two-particle antisymmetrized matrix elements were calculated. Two different ways were used in the construction of the interaction term: The parameters A_0 and A_1 were considered to be state independent, thus being constant in the configuration space, the parameters A_0 and A_1 were allowed to vary in the dependence of the combination of j values. In order to simulate this dependence three values for A_0 and A_1 were fitted. The reasons of this assumption are discussed. In the calculations performed in these two versions the parameters A_0 and A_1 were adjusted to produce the best agreement with the experimental level schemes. The energy matrices were diagonalized and the calculated level schemes for both ^{42}Ca and ^{42}Sc nuclei are presented. In the both nuclei the density of the calculated levels is significantly less than of the observed levels. This fact leads to the conclusion that some core excitation models play an important role in the formation of low-lying states in the ^{42}Ca and ^{42}Sc nuclei. (auth)

31757 GAMMA DECAY OF THE FIRST $T=3/2$ LEVEL IN ^{41}Sc. Fortier, S.; Laurent, H.; Schapira, J.P. (Institut de Physique Nucléaire, 91406 Orsay, France); Antony, M.S.; Knipper, A. Phys. Rev. C 13: No. 3, 1049-1054 (Mar 1976).

The first $T=3/2$ level in ^{41}Sc has been excited as a resonance in the ^{40}Ca$(p,\gamma)^{41}$Sc reaction, at incident energy $E_p=4974\pm5$ keV. Transitions to the levels at 2.668, 3.415, 3.777, and 4.248 MeV have been observed, and their radiative widths determined. Multipole mixing ratios have been obtained from angular distribution measurements. The comparison between radiative strengths and ft values for the β^+ decay of the ^{41}Ti ground state suggests that an important part of the $[1f^{-1}_{7/2|j=1,t=0}\ 1d_{3/2}]_{J=5/2,T=1/2}$ configuration could be in the 4.248 MeV level. The γ decay of the first $T=3/2$ level is also compared to that of its analog in ^{41}Ca, giving a strong indication that the $T=1/2$ levels in ^{41}Sc at 2.668, 3.415, 3.777, and 4.248 MeV are, respectively, the analogs of those at 2.605, 3.400, 3.740, and 4.094 MeV in ^{41}Ca. (auth)

31758 ELASTIC SCATTERING OF POLARIZED PROTONS FROM ^{56}Fe IN THE GIANT RESONANCE REGION OF ^{57}Co. Weller, H.R.; Szücs, J.; Kuehner, J.A.; Jones, G.D.; Petty, D.T. (Tandem Accelerator Laboratory, McMaster University, Hamilton, Ontario, Canada). Phys. Rev. C 13: No. 3, 1055-1060 (Mar 1976).

The proton elastic scattering cross sections and analyzing powers for ^{56}Fe have been measured for proton energies from 8.0 to 17.0 MeV. Excitation curves were measured in 100 keV steps at eight angles from $E_p=9.3$ to 16.5 MeV. Angular distributions of cross sections and analyzing powers were measured at 18 angles in ~7.5° steps over the range of ~20° to ~150° in 1.0 MeV steps from 8.0 to 17.0 MeV. A phase shift analysis indicates that the $d_{5/2}$ partial wave has the most significant energy dependence in this energy region. It is shown that this energy dependence can be essentially accounted for by the presence of a single resonance with parameters consistent with those which would be expected for the giant dipole resonance of ^{57}Co. (auth)

31759 ISOSCALAR TRANSITION RATES VIA ^{40}Ca, ^{208}Pb(α,α') AT 79 MeV. Rutledge, L.L. Jr.; Hiebert, J.C. (Cyclotron Institute and Physics Department, Texas A&M University, College Station, Texas 77843). Phys. Rev. C 13: No. 3, 1072-1082 (Mar 1976).

The inelastic scattering of α particles from ^{40}Ca and ^{208}Pb has been studied at a bombarding energy of 79.1 MeV. Isoscalar transition rates have been extracted for the 2^+ level at 3.90 MeV, the 3^- levels at 3.73, 6.29, and 6.58 MeV, and the 5^- level at 4.48 MeV in ^{40}Ca. These have been compared to previous results, and a slight energy dependence is evident. In the case of ^{208}Pb, the isoscalar transition rates have been extracted for the 2^+ level at 4.09 MeV, the 3^- level at 2.62, and the 5^- levels at 3.22 and 3.73 MeV. The analysis of the Coulomb and nuclear interference for the 2^+ level at 4.09 MeV indicates that $\beta_{Coulomb}=1.2\beta_{nuclear}$. A folding model analysis has been made for the 3.73-MeV (3^-) and 3.90-MeV (2^+) levels in ^{40}Ca and the 2.62-MeV (3^-) and 4.09 MeV (2^+) levels in ^{208}Pb. This analysis, using an effective α particle, bound nucleon interaction determined from 79-MeV elastic α-scattering data, is compared to a standard deformed optical potential analysis. Agreement between the two analyses is best for the 2^+ state in ^{208}Pb and worst for the 3^- state in ^{40}Ca. The explicit inclusion of exchange effects tends to reduce the discrepancy between the two reaction models. (auth)

31760 EFFECT OF DEORIENTATION IN RECOIL-DISTANCE LIFETIME MEASUREMENTS. Rascher, R.; Lieb, K.P.; Uhrmacher, M. (Institut für Kernphysik, Universität zu Köln, Köln, Germany). Phys. Rev. C 13: No. 3, 1217-1225 (Mar 1976).

The influence of hyperfine deorientation in recoil-distance Doppler shift measurements was studied for high spin states in ^{38}Ar, ^{40}K, ^{41}K, and ^{41}Ca having lifetimes in the range between 30 ps and 10 ns. At a recoil velocity of v/c=0.02, deorientation *in vacuo* was found to be negligible for lifetimes up to several ns. (auth)

31761 INTERPLAY OF VALENCE-SHELL CLUSTERS AND THE VIBRATIONAL FIELD IN ^{58}Ni. Berghe, G. vanden (Ghent Rijksuniversiteit (Belgium). Seminarie voor Wiskundige Natuurkunde). Z. Phys., A; 274: No. 1, 51-57(Aug 1975).

The level scheme and electromagnetic properties of ^{58}Ni are described in the two-particle cluster core coupling model without parameter fitting. The present results are compared to previous shell-model and quasi-particle calculations. To explain the enhanced E2 transitions a neutron effective charge of e is needed, while the bare value for the vibrator charge has been used. (DE)

31762 HARD CORE IN THE ANALYSIS OF ELASTIC SCATTERING OF α PARTICLES. Gonchar, V. G.; Terenetskii, K. O.; Tokarevskii, V. V. (Inst. of Nuclear Physics, Moscow). Yad. Fiz.; 23: No. 1, 87-92(Jan 1976). (In Russian)

The experimental cross sections of elastic scattering of α particles on ^{46,50}Ti nuclei are analyzed in the framework of the optical model with the hard core potential. It is shown that the hard core consideration does not contradict the α-particle elastic scattering data. The hard core potential has allowed one to describe the increase of the elastic scattering cross section at large angles for the ^{50}Ti nucleus. (auth)

31763 STUDY OF COULOMB-NUCLEAR INTERFERENCE IN INELASTIC SCATTERING OF ^{9}Be IONS BY ^{58}Ni NUCLEI. Glukhov, Yu. A.; Man'ko, V. I.; Novatskii, B. G.; Ogloblin, A. A.; Sakuta, S. B.; Stepanov, D. N.; Titov, A. I.; Chuev, V. I. (Inst. of Atomic Energy, Moscow). Yad. Fiz.; 23: No. 1, 3-7(Jan 1976). (In Russian)

The Coulomb-nuclear interference effects in inelastic scattering of ^{9}Be ions by ^{58}Ni nuclei with excitation of the 1.45 MeV (1^+) collective state are studied experimentally. Angular distributions of elastic and inelastic scattering are measured at 26.3 MeV energy of ^{9}Be ions. It is shown that the semiclassical model fits the data well. The obtained values of nuclear potential parameters show that at large distances the decrease rate of the nuclear density seems to be determined by the "tails" of the wave functions of the most weakly bound fragments produced from virtual decay of the incident particle. (auth)

31764 ENERGY DEPENDENCE OF ^{51}V(d, ^{3}He)^{50}Ti; IMPLICATIONS FOR DISTORTED-WAVE-BORN-APPROXIMATION ANALYSIS AND REARRANGEMENT. Craig, J.N.; Wall, N.S. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742); Bassel, R.H. Phys. Rev. Lett. 36: No. 12, 656-660 (22 Mar 1976).

The differential cross section as a function of energy has been carefully measured and analyzed for the ground and first three excited states in the reaction ^{51}V(d, ^{3}He)^{50}Ti. The results show no evidence for rearrangement effects. Finite-range, distorted-wave Born-approximation calculations, which are necessary to fit the data, yield spectroscopic factors about 0.6 of those expected on the basis of an $(f_{7/2})^3$ description of ^{51}V and a conventional (d, ^{3}He) normalization. (auth)

31765 SEMIMICROSCOPIC ANALYSIS OF ^{44}Ca(α, α) FROM 18.0 TO 49.5 MeV. Michel, F. (Faculté des Sciences, Université de l'Etat, 7000 Mons, Belgium). Phys. Rev. C 13: No. 4, 1446-1450 (Apr 1976).

The elastic α-particle scattering from ^{44}Ca for incident energies between 18.0 and 49.5 MeV is studied in the frame of a folding model using the free α-nucleon interaction. The energy dependence of the imaginary form factor and that of the real well depth are deduced. (auth)

31766 MASS OF ^{35}K. Benenson, W.; Guichard, A.; Kashy, E.; Mueller, D.; Nann, H. (Cyclotron Laboratory and Physics Department, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 13: No. 4, 1479-1482 (Apr 1976).

The ^{40}Ca(^{3}He, ^{8}Li)^{35}K reaction at 73.7 and 75.8 MeV was employed to make the first observation of ^{35}K and to measure its mass. The Q value for the reaction was found to be -29.693 ± 0.020 MeV and the mass excess to be -11.170 ± 0.020 MeV. Excited states of ^{35}K were found at 1.56 and 2.69 MeV. (auth)

31767 PROMPT GAMMA RAYS FROM NUCLEAR REACTIONS INDUCED BY 380-MeV π^-. Segel, R.E.; Greenwood, L.R. (Northwestern University, Evanston, Illinois 60201); Debevec, P.; Jackson, H.E.; Kovar, D.G.; Meyer-Schützmeister, L.; Monahan, J.E.; Serduke, F.J.D.; Wangler, T.P.; Wharton, W.R.; Zeidman, B. Phys. Rev. C 13: No. 4, 1566-1576 (Apr 1976).

Using a Ge(Li) detector, γ-ray spectra coincident with incident 380-MeV π^- have been measured for targets of S, Ar, Ca, V, ^{60}Ni, and As. The production cross sections for identified γ rays vary from about 200 to about 500 mb, depending on the target, although there is considerable uncertainty in the absolute cross sections. Comparison with data taken at lower energies leads to the conclusion that the spectra do not significantly change with pion energy over the range 100 MeV $\leq T_\pi \leq$ 400 MeV. Formation of nuclei which can be made by removing an integral number of α particles, or, in the case of odd targets, a triton plus an integral number of α particles, appears to be usually favored but it is not certain that it is necessary to invoke special clustering effects in order to explain the presently available data. Some clues as to the reaction mechanism can be found in the data. (auth)

31768 DECAYS OF ^{88}Kr AND ^{88}Rb. Bunting, R.L.; Talbert, W.L. Jr.; McConnell, J.R. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50010); Meyer, R.A. Phys. Rev. C 13: No. 4, 1577-1589 (Apr 1976).

The γ rays following the β decays of ^{88}Kr and ^{88}Rb have been studied, using both large volume Ge(Li) detectors for singles and coincidence measurements and anti-Compton spectrometry for singles measurements. Level schemes for ^{88}Rb and ^{88}Sr were constructed from the data and 74 of 81 γ rays observed in the decay of ^{88}Kr were placed in the ^{88}Rb level scheme with 23 excited states. For the decay of ^{88}Rb, all of the observed 27 γ rays have been placed in the (well known) level structure of ^{88}Sr. Spin and parity assignments have been deduced from β-decay logft values and γ-ray transition patterns. Possible shell model interpretations are presented for the level schemes. (auth)

31769 UPPER LIMIT ON $\Delta T = 2$, $E2$ TRANSITION IN ^{44}Ti. Dixon, W.R.; Storey, R.S. (National Research Council of Canada, Ottawa, Ontario, Canada K1A OS1); Simpson, J.J.; Lawson, R.D. Phys. Rev. C 13: No. 4, 1745-1747 (Apr 1976).

An upper limit of 0.16% (one standard deviation) is placed on the γ-ray branching ratio for the ΔT=2 transition from the T=2 0^+ level at 9338±2 keV in ^{44}Ti to the first excited 2^+ level at 1083 keV. A new determination of $\Gamma_a\Gamma_\gamma/\Gamma$ for the T=2 level gives 0.24 eV. The upper limit for the ΔT=2 transition is shown to be consistent with shell-model estimates of isospin mixing. (auth)

31770 ALPHA-^{40}Ca OPTICAL POTENTIALS: DENSITY DEPENDENT INTERACTIONS. Brissaud, I.; Brussel, M.K. (Department of Physics, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). Phys. Rev. C 13: No. 4, 1748-1750 (Apr 1976).

A linear density dependent effective nucleon-nucleon interaction is used in a folding model to analyze 166 MeV α-particle elastic scattering data from ^{40}Ca. A phenomenological imaginary potential is added to the real potential generated by the model. The density dependence used is insufficient to fit the experimental angular distribution quantitatively. We point out the nature of the change in the optical potential required to achieve better results. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 28587, 30850, 31682, 31693, 31699, 31714, 31722, 31725, 31748, 31749, 31753, 31754, 31767, 31787, 31790, 31804, 31878, and 31903.

31771 (BNL-NCS-50468) NEUTRON CROSS SECTIONS OF ^{59}Co BELOW 100 keV. Mughabghab, S. F.; Krieger, T. J (Brookhaven National Lab., Upton, N. Y. (USA)). Apr 1975. Contract E(30-1)-16. 45p. (ENDF-229). Dep. NTIS $5.50.

The neutron cross sections for ^{59}Co have been evaluated in the energy range 10^{-5}eV-100 keV for ENDF/B-IV. Total and scattering cross sections are described by multilevel Breit-Wigner resonance parameters and the capture cross section is calculated using a single level Breit-Wigner formalism. The evaluation differs from the previous ENDF/B-III (in the resonance region basically in two ways: (1) the resonance region has been extended from 35 keV to 100 keV, (2) to describe thermal capture, scattering, total cross sections, and polarization data, a single s-wave bound level with spin 3 is evoked rather than the previous two bound levels with spins 3 and 4. This follows from using a radiative width of 0.48 eV for the spin 4 resonance at 132 eV rather than the 0.40 of ENDF/BIII. Comparisons with existing measurements are made. 57 references, 9 tables, 10 figures (SDF)

31772 (CEA-CONF-3295) EXPERIMENTAL AND THEORETICAL CAPTURE CROSS-SECTION EVALUATIONS FOR YTTRIUM BETWEEN 10 keV AND 3 MeV. Philis, C.; Thomet, P.; Verges, N. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). 1975. 18p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

Theoretical and experimental capture cross section evaluations have been completed from 10 keV to 3 MeV for ^{89}Y. The experimental evaluation is based on the normalization to consistent set of standards of the experimental results up to 12.31.74. The formalism used for the theoretical evaluation is the statistical model. The good agreement between the two independent results of our studies provides confidence in the results for ^{87}Y and ^{88}Y obtained using the same model over the same energy range. (FR)

31773 (CEA-CONF-3303) ELASTIC AND INELASTIC SCATTERING OF FAST NEUTRONS FROM THE EVEN ISOTOPES OF Se. Lachkar, J.; Haouat, G.; Mc Ellistrem, M. T.; Patin, Y.; Sigaud, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). 1975. 14p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

The differential cross sections for elastic and inelastic scattering of neutrons by ^{76}Se, ^{78}Se, ^{80}Se and ^{82}Se have been measured at 8-MeV incident neutron energy, and by ^{76}Se and ^{82}Se at 6- and 10-MeV incident energies. The differences observed in the elastic scattering cross sections are interpreted as an effect of the isospin term in the scattering potential. A detailed analysis of the elastic scattering data is presented. (FR)

31774 (CEA-CONF-3306) (n,n'γ) REACTION STUDY FOR THE Se AND Ge EVEN ISOTOPES. Sigaud, J.; Patin, Y.; Mc Ellistrem, M. T.; Haouat, G.; Lachkar, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 15p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

The energy levels and the decay schemes of ^{78}Se and ^{80}Se have been studied through the measurements of (n,n'γ) differential cross sections. Gamma-ray excitation functions have been measured between 2,0 and 4,1 MeV incident neutron energy, and angular distribution have been observed for all of these isotopes at 3 MeV neutron energy. (FR)

31775 (ISN-75-45) ^{61}Ni, ^{62}Ni(p,d) REACTIONS. Koang, D. H.; Chien, W. S.; Rossner, H. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1975. 24p. INIS.

The ^{61}Ni, ^{62}Ni(p,d) reactions were studied at 40 MeV. A very pronounced j-dependence effect was observed for the l = 3 transitions. Spins and parities are assigned to levels of ^{61}Ni which include two $\frac{1}{2}^+$ states. Spectroscopic factors extracted from DWBA analysis are compared to shell model predictions. (FR)

31776 A NEW ISOTOPE ^{83}Zr. Kaba, M.; Miyano, K. Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Department). Radiochim. Acta; 21: No. 3/4, 203-205(1974). (In German)

3 figs.; 1 tab.; 4 refs.

A new isotope ^{83}Zr was produced with the ^{54}Fe (^{32}S, 2 pn) reaction. The obtained half-life is 42 ± 7 sec. Seven γ-rays at energies of 106 keV (10%), 117 keV (2%), 256 keV (8%), 303 keV (7%), 475 keV (9%), 791 keV (4%) and 1,525 keV (9%) were assigned to the β-decay of ^{83}Zr. (DE)

31777 THE γ-RAY SPECTRUM OF 17.8-MIN ^{88}Rb. Erten, H. N. (Middle East Technical Univ., Ankara (Turkey). Dept. of Chemistry); Blachot, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). Radiochim. Acta; 21: No. 3/4, 206-209(1974).

2 figs.; 1 tab.

The γ-ray spectrum of 17.8-min ^{88}Rb has been studied using large Ge(Li) detectors. There exists some discrepancies among the most recent Ge(Li) γ-ray studies, concerning the presence of a number of low intensity γ-rays. An attempt has been made in this work to resolve the discrepancies. Two previously unobserved γ-rays of 2,007.7- and 2,905.7-keV energy were also observed in this work. (DE)

31778 ANALYSIS OF COMPOUND NUCLEUS CONTRIBUTIONS FROM (α, p) REACTIONS IN Ni AND Sn REGIONS. Chan, K.C.; Shabason, L.; Alzona, J.E.; Cohen, B.L. (University of Pittsburgh, Nuclear Physics Laboratory,, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 13: No. 3, 1112-1116 (Mar 1976).

Compound nucleus contributions to (α, p) reactions on nuclei in the Ni and Sn regions are obtained and compared with Hauser-Feshbach calculations. The noncompound nucleus contributions are found to change mainly the spectral magnitude of the cross section without substantially affecting the spectral shape. Both Gilbert-Cameron and back-shifted parameters deduced from level counting data give cross sections in reasonable agreement with experiment. (auth)

31779 (^{3}He,d) STRIPPING TO UNBOUND ANALOG STATES IN Cu ISOTOPES. Boudard, A.; Bruge, G.; Chaumeaux, A. (Centre d'Etudes Nucléaires de Saclay, France); Finkel, G.; Ashery, D.; Yavin, A.I. Phys. Rev. C 13: No. 3, 1123-1131 (Mar 1976).

The (^{3}He,d) reaction on Ni isotopes was studied at 30.2 MeV bombarding energy. Twenty-six unbound analog states in Cu isotopes were populated, and the observed differential cross sections are presented. Two different distorted-wave Born-approximation methods for stripping calculations to unbound analog states were used in the analysis. Proton spectroscopic factors were deduced and compared with published neutron spectroscopic factors for the parent states. The agreement is generally good, except for the pair of isotopes ^{62}Ni-^{62}Cu. The different sensitivity to the transferred angular momentum of the corresponding (d,p) and (^{3}He,d) reactions is discussed. The present data are compared with the results of previous studies of the (^{3}He,d) reaction in the $A \sim 90$ mass region. It is concluded again that the (^{3}He,d) reaction to analog states is complementary to the (d,p) reaction for the study of levels in the parent states which are populated through large angular momentum transfers. (auth)

31780 MULTISTEP PROCESSES IN TRANSFER REACTIONS INDUCED BY 56 MeV ^{16}O BEAM ON ^{72,74,76}Ge ISOTOPES. Cobern, M.E.; Lemaire, M.C.; Low, K.S.; Mermaz, M.C.; Sztark, H. (Département de Physique Nucléaire, Centre d'Etudes Nucléaires Saclay, BP 2, 91190, Gif sur Yvette, France); Udagawa, T.; Tamura, T. Phys. Rev. C 13: No. 3, 1200-1210 (Mar 1976).

Angular distributions of the (^{16}O, ^{14}C) reaction on ^{72,74,76}Ge targets were measured using a 56 MeV ^{16}O beam in 2° steps between 13° and 70° laboratory angles. The experiments were performed using three solid state detector telescopes. The observed difference between the shapes of the angular distributions of the ground states and the excited states indicates that an important role is played by multistep processes, involving vibrational excitation of the target and residual nuclei. It was found that the exact-finite-range coupled-channel-Born-approximation calculations were able to reproduce qualtitatively the observed variation of the angular distributions. (auth)

31781 RESONANCE FLUORESCENCE STUDIES OF LEVELS IN ^{63}Cu AND ^{65}Cu. Swann, C.P. (Bartol Research Foundation of the Franklin Institute, Swarthmore, Pennsylvania 19081). Phys. Rev. C 13: No. 3, 1104-1111 (Mar 1976).

The properties of levels in ^{63}Cu and ^{65}Cu have been investigated using the resonance fluorescence technique with bremsstrahlung serving as the source of exciting radiation. The energies and scattering cross sections for 24 levels in ^{63}Cu and 30 levels in ^{65}Cu up to about 4.5 MeV were measured. A few levels known to exist in the region of 2 MeV for both nuclei were not observed. For a number of the lower lying levels, spin and parity assignments have been made through angular distribution measurements and limits on J^π set by others. Mixing ratios for a few of these are also given. Where J^π and the ground state branching ratios are known the partial widths for decays to the ground state are presented. Comparisons are made with the predictions of the latest theoretical calculations. (auth)

31782 DECAY OF THE 46.6 S ^{75}Ge^m. Bhattacharyya, P.; Chattophadhyay, R. K.; Sethi, B.; Tikku, V. K.; Mukherjee, S. K. (Saha Inst. of Nuclear Physics, Calcutta). Nuovo Cim., A; 31A: No. 3, 519-528(1 Feb 1975).

The decay of the 46.6 s isomer of ^{75}Ge is investigated by gamma-spectroscopic measurements using an enriched ^{76}Ge target and high resolution x-ray Ge(Li) and 32.2 cm^3 Ge(Li) detectors. New γ-rays were found at energies 61.92, 77.86, 121.15, 136.01, 279.48, and 400.20 keV, in addition to a strong γ-ray at 139.68 keV, which was previously known to occur in the decay of ^{75}Ge^m. The K conversion coefficient of the 139.68 keV transition was measured and found to be 140 ± 0.07, supporting an E3 multipolarity assignment for this transition in ^{75}Ge. A decay scheme for the 46.6 s ^{75}Ge^m is proposed which shows for the first time a β-decay to ^{75}As, populating a level at 400.60 keV, and a cascade of γ-rays of energies 77.86 and 61.92 keV in ^{75}Ge in addition to a cross over transition of 139.68 keV, populating the ground state of ^{75}Ge. The half-life of the 139.68 keV level in ^{75}Ge was determined. The intensity and log ft of the new β-group, and the spins and parities of the levels in ^{75}Ge are given and the results are discussed.

31783 STUDY OF THE NUCLEI ^{85}Sr, ^{86}Sr, AND ^{101}Tc. Begzhanov, R. B.; Salimov, S. Kh.; Teshabaev, K. T. (Tashkent State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 15-19(1975). (In Russian)

Results are presented on a study of the angular correlation of a series of cascade γ-emissions in the nuclei Sr-85, Sr-86 and Te-101. On the basis of the data which were obtained the

spins of the level and the multiplicities of the transitions are established. (tr-auth)

31784 ENERGY DEPENDENCE OF TRANSFER REACTIONS ON ^{64}Zn AND TWO-STEP PROCESSES. Guazzoni, P.; Pignanelli, M. (Istituto di Scienze Fisiche dell'Università di Milano, Italy); Colombo, E.; Crescentini, F. Phys. Rev. C 13: No. 4, 1424-1433 (Apr 1976).

Differential cross sections, at proton incident energies between 23.3 and 42.4 MeV, have been measured for the following reactions: ^{64}Zn(p, d)^{63}Zn, ^{64}Zn(p, t)^{62}Zn, and ^{64}Zn(p, α)^{61}Cu. The data are compared with distorted wave Born approximation calculations. Although good results for the (p, d) data are obtained, attempts to fit the experimental energy dependence of the (p, t) and (p, α) reactions are less successful. The effects of two-step processes have been investigated. It is shown that the (p, d, t) successive single-neutron pickup can provide a satisfactory description of the energy dependence of the (p, t) cross sections. (auth)

31785 ^{61,62}Ni(p, d) REACTIONS. Koang, D.H.; Chien, W.S.; Rossner, H. (Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 13: No. 4, 1470-1478 (Apr 1976).

The ^{61,62}Ni(p, d) reactions were studied at 40 MeV. A very pronounced j-dependence effect was observed for the $l = 3$ transitions. Spins and parities are assigned to levels of ^{61}Ni which include two $1/2^+$ states. Spectroscopic factors extracted from distorted-wave Born-approximation analysis are compared to shell-model predictions. (auth)

31786 ARGON- AND KRYPTON-INDUCED REACTIONS AT ENERGIES OF 4–7 MeV/amu. Britt, H.C.; Erkkila, B.H.; Stokes, R.H. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545); Gutbrod, H.H.; Plasil, F.; Ferguson, R.L.; Blann, M. Phys. Rev. C 13: No. 4, 1483-1495 (Apr 1976).

Counter telescope measurements of reactions of ^{40}Ar + ^{109}Ag have been made at laboratory energies between 169 and 337 MeV, ^{40}Ar + ^{121}Sb at 282 and 340 MeV, and ^{84}Kr + ^{63}Cu at 494 and 604 MeV. Measurements and results include elastic scattering, evaporation residue angular distributions and cross sections, fission plus quasifission angular distributions, kinetic energy distributions, and yields versus atomic number. Evaporation residue yields are shown to be consistent with limits predicted by evaporation calculations which include fission competition. Fusion cross sections for the ^{40}Ar plus ^{109}Ag or ^{121}Sb systems are shown to be consistent with the liquid drop limit in terms of the angular momentum at which the fission barrier is estimated to go to zero. Kinetic energies of the fissionlike yields are compared with predicted values. (auth)

31787 SYSTEMATICS OF $N = 45$ NUCLEI. Medsker, L.R. (Department of Physics, Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 13: No. 4, 1751-1752 (Apr 1976).

A reinterpretation of the available data on $^{81}_{36}Kr_{45}$ allows an extension of the systematic study of low-lying $7/2^+$ and $9/2^+$ levels in the $N = 45$ isotones. (auth)

31788 GAMMA-GAMMA DIRECTIONAL CORRELATION STUDIES ON ^{77}Ge DECAY. Lent, E. M. Davis, CA; Univ. of California (1975). 165p. University Microfilms Order No. 76-1792.

Thesis (Ph. D.).

The decay properties of the levels in ^{77}As were investigated following the decay of 11.3 hour ^{77}Ge. Singles gamma-ray energy and intensity measurements were obtained with a 54 cm^3 high resolution Ge(Li) detector. Extensive gamma-gamma coincidence and directional correlation measurements were obtained with large coaxial Ge(Li) detectors. An improved decay scheme was constructed. From gamma-gamma correlation measurements, deduced log ft values, and internal conversion coefficients, the J/sup pi/ values for the following levels were confirmed: g.s., $3/2^-$; 215.51, $3/2^-$; 264.41, $5/2^-$; 475.45, $9/2^+$; 614.49, $3/2^-$ or $5/2^+$; 631.82, $5/2^+$; 1189.81, $7/2^+$; and 1560.67, $5/2^+$. Further J/sup pi/ values were proposed as follows: 194.75, $1/2^-$; 1528.32, $5/2^-$; 1538.80, $3/2^-$ or 5/2; 2000.16, $5/2^+$; 2341.64, 5/2 or 7/2; 2354.12, 5/2 or 7/2; and 2543.70, 5/2 or 7/2. The following delta(E2/M1) mixing ratios were obtained: 215.51-keV, -0.164 +- 0.16 or -0.321 +- 0.011; 558.02-keV, -0.139 +- 0.006; 810.35-keV, 0.194 +- 0.030 or 2.37 +- 0.18; 928.85-keV, -0.63 +- 0.41; 1263.86-keV, -1.41 +- 0.06 or -0.079 +- 0.013; 1312.80-keV, -5.86 +- 1.7 or -1.03 +- 0.11; and 1368-keV, -21. +- 12. or 0.519 +- 0.49. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 29221, 30496, 30850, 31682, 31699, 31714, 31725, 31740, 31749, 31755, 31778, 31783, 31786, 31807, 31881, 31903, and 31932.

31789 (CEA-CONF-3293) ^{140}Ce(d,n)^{141}Pr REACTION STUDY AT E_d = 12 MeV. Adam, A.; Bersillon, O.; Joly, S. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 9p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

The ^{140}Ce(d,n)^{141}Pr reaction has been studied at 12 MeV deuteron bombarding energy using the time-of-flight technique for neutron detection. The experimental cross sections were analysed in the framework of the DWBA theory to deduce l(p) and spectroscopic factors. These experimental results are compared with data from (^{3}He,d) studies and from shell model calculations. (FR)

31790 (CEA-CONF-3300) OPTICAL MODEL PARAMETRIZATION BETWEEN 10 keV AND 20 MeV. Application to the Spherical Nuclei ^{89}Y AND ^{93}Nb. Lagrange, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 14p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

Fast neutron cross sections for ^{89}Y and ^{93}Nb were calculated in the energy range 10 keV–20 MeV with the spherical optical model. The optical potential parameters used were obtained from a comparison theory-experiment using strength functions, potential scattering radius, total cross sections and differential elastic scattering data. (FR)

31791 (COO-2479-6) PRECISION NEUTRON CROSS SECTION MEASUREMENTS IN SUPPORT OF THE LMFBR PROGRAM. Progress Report for January 1, 1975–December 31, 1975. Block, R. C.; Hockenbury, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). RPI Linac Lab.). 1975. Contract AE(11-1)-2479. 27p. Dep. NTIS $4.00.

Research progress is reported for the following projects: (1) the neutron total cross section of sodium near minimum, (2) ^{238}U(n, gamma) measurements with Fe-filtered neutron TOF beams, (3) neutron capture and transmission measurements on ^{101}Ru, ^{102}Ru, ^{104}Ru, ^{145}Nd, and ^{149}Sm, (4) capture cross section normalization and analysis of ^{101}Ru, ^{102}Ru, ^{104}Ru, ^{145}Nd, ^{149}Sm, (5) neutron capture and transmission experiments on ^{95}Mo, ^{97}Mo, ^{133}Cs, and ^{143}Nd, (6) capture cross section measurements of radioactive fission products, and (7) neutron capture and transmission data analysis system. (SDF)

31792 (INR-1467/2/PS/A) THE MOESSBAUER EFFECT ON ^{125}Te IN SEMICONDUCTOR COMPOUNDS OF Hg ^{125}Te AND Cd^{125}Te. Bielecki, M.; Suwalski, J.; Dabrowski, L. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 21p. INIS.

The experimental methods of observation of 35.48 keV transitions in ^{125m}Te are described. The results of the Mössbauer effect measurements in semiconductors HgTe and CdTe enriched in ^{125}Te isotope and in standard absorber $^{125}TeO_2$ are presented. The experimental values of the isomer shift and their dependence on the ionic character of the $A_{II} - B_{VI}$ type semiconductor bounds are also discussed. (auth)

31793 (UUIP-895) B(E2,0^+-2^+) FOR Xe ISOTOPES, REVISITED. Edvardson, L. O.; Norlin, L. O. (Uppsala Univ. (Sweden). Fysiska Institutionen). Mar 1975. 7p. INIS.

Transition moments and lifetimes have been deduced from measurements of the Coulomb excitation cross sections for ^{128,130,132,134,136}Xe isotopes. The results are for B(E2) [0.79(4); 0.58(5); 0.50(4); 0.34(6); 0.18(8)] $e^2 \times 10^{-48}$ cm^4 and for $\tau(2^+)$ [29.9(15); 15.5(14); 6.1(5); 2.9(5); 0.58(26)] ps going from ^{128}Xe to ^{136}Xe. (auth)

31794 (UUIP-898) DIRECT DETERMINATION OF THE SIGN OF THE MULTIPLE COULOMB EXCITATION INTERFERENCE TERM IN ^{102}Ru. Fahlander, C.; Hasselgren, L.; Thun, J. E.; Bockisch, A.; Klein, G.; Kleinfeld, A.; Gelberg, A.; Lieb, P. (Uppsala Univ. (Sweden). Fysiska Institutionen). Apr 1975. 8p. INIS.

A direct determination of the sign of the Coulomb interference term $P_3 = M_{02}M_{22} + H_{02}$, in ^{102}Ru is presented. P_3 is found to be negative if the matrix elements are defined with the inclusion of the i^λ-factor. (auth)

31795 (UUIP-905) COULOMB EXCITATION IN ^{99}Tc. Svensson, L. G.; Sarantites, D. G.; Baecklin, A. (Uppsala Univ. (Sweden). Fysiska Institutionen). Apr 1975. 22p. INIS.

^{99}Tc has been studied in Coulomb excitation with ^{4}He and ^{16}O. Two new levels at 625.4 and 1081.4 keV were established on the basis of γ–γ coincidence relations. The γ-ray angular distributions obtained support a doublet character of the earlier observed 761.8 keV level. The lifetimes of the levels at 726.7, 761.7, 762.0 and 1081.4 keV were measured by means of the Doppler shift attenuation method using ^{16}O ions and the obtained half-lives were 1.8 ± 0.2, 0.7 ± 0.4, 2.4 ± 0.3, and 0.9 ± 0.3 ps, respectively. (auth)

31796 VUV EMISSION OF Xe III LEVELS EXCITED BY ELECTRON IMPACT VIA $N_{4,5}OO$ AUGER TRANSITIONS. Hertz, H. (Hamburg Univ. (F. R. Germany). Inst. fuer Angewandte Physik). Z. Phys., A; 274: No. 4, 289-291(Oct 1975).

2 figs.; 21 refs.

Optical excitation functions were measured for Xenon emission lines. The Xe III $5s5p^5$ levels are excited in two different processes, by a direct two electron ejection and by a 4d ionization followed by an Auger decay. An emission line found at 1,089.0 A is excited by 4d ionization. This line is assigned to the Xe III transition $5s5p^5{}^1p^0 - 5s^05p^6{}^1S$. The ^1S energy level amounts to 26.14 eV. (DE)

31797 DETERMINATION OF THE K-SHELL ELECTRON CAPTURE PROBABILITY P(K) IN THE DECAY OF ^{139}Ce. Hansen, H. H.; Mouchel, D. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Z. Phys., A; 274: No. 4, 335-337(Oct 1975).

2 tabs.; 11 refs.

A new coincidence procedure for the determination of the K-shell electron capture probability in simple EC decays is described. By measuring γ-rays and K-shell conversion electrons separately and in coincidence with the K X-rays the K capture probability can be deduced only from counting rates. The method has been applied to ^{139}Ce. The result of $P(K) = 0.726 \pm 0.010$ is in fairly good agreement with other experimental values reported previously. (DE)

31798 PRODUCTION OF CARRIER FREE ^{113}Sn BY DEUTERON IRRADIATION OF INDIUM. Karpeles, A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Departamento de Radioisotopos). Radiochim. Acta; 21: No. 3/4, 164-168(1974).

4 figs.; 2 tabs.; 11 refs.

Experimental measured cross sections for the In(d,xn) ^{113}Sn reaction by irradiation of natural indium with deuterons are reported. A stacked foil arrangement was used and the excitation function in the range between 27.5 MeV and the Coulomb threshold was obtained. Total flux measurements were performed with aluminium monitor foils. The ^{113}Sn content was determined measuring the γ rays emitted by the daughter, ^{113}In, in equilibrium. The overall error in absolute cross sections was estimated as ±20%. The excitation function for the ^{113}In(d,2n) ^{113}Sn reaction was compared with LANGE and MUENZE's semiempirical values. Position, shape and peak's half width agrees with these predictions, but the maximum of the experimental curve is higher than the predicted. This divergency can possibly be explained because a proton magic number nucleus is built. The yield of the conventional ^{112}Sn(n,γ) ^{113}Sn reactor production method and the studied accelerator yield were critically confronted and it was shown that the deuteron product will be preferred because higher relative yields and a carrier-free ^{113}Sn will be obtained. (DE)

31799 MOESSBAUER CONVERSION SPECTROSCOPY. Measurements on the First Excited States of ^{180,182}W and ^{145}Pm. Bokemeyer, H.; Wohlfahrt, K.; Kankeleit, E.; Eckardt, D. (Technische Univ. Darmstadt (F. R. Germany). Inst. fuer Kernphysik). Z. Phys., A; 274: No. 4, 305-318(Oct 1975).

14 figs.; 5 tabs.; 73 refs.

The Moessbauer Conversion (MBC) spectroscopy and criteria for its useful application are discussed and compared with other MB-techniques. By help of the MBC spectroscopy the isomer shift of the first excited state in ^{182}W was measured and a change in radius $-0.05 \times 10^{-4} > \Delta [r^2]/[r^2] > -0.28 \times 10^{-4}$ derived. The ratio of quadrupole moments of first excited states in ^{180}W and ^{182}W turns out to be $^{180}Q/^{182}Q = 0.976(30)$. Due to the excellent statistical quality of the spectra the interference parameter of the 100 keV E2 transition in ^{182}W could be determined to $2\beta = 0.0165(9)$ for the L-shell. The MB-effect for the 61 keV transition in the instable ^{145}Pm has been detected for the first time. A width $\Gamma_{exp} = 2.15(58)$ mm/s was obtained. (DE)

31800 TWO QUASI-PARTICLE LEVELS IN ^{136}Ba AND THE DECAY OF ^{136}Cs. Griffioen, R. D. (Calvin Coll., Grand Rapids, Mich. (USA). Dept. of Physics); Gunnink, R.; Meyer, R. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Z. Phys., A; 274: No. 4, 391-394(Oct 1975).

3 figs.; 1 tab.; 21 refs.

The decay of 13-day ^{136}Cs has been studied using high-resolution Ge(Li) detectors. Several low-intensity γ rays were observed for the first time. New levels have been deduced in ^{136}Ba at energies of 2,356.7 and 2,372.7 keV. (DE)

31801 STRUCTURE OF EXCITED STATES IN ^{100}Mo AND ^{102}Mo FROM SPECTROSCOPY USING ^{18}O INDUCED REACTIONS. Bohn, H.; Kienle, P. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Department); Proetel, D.; Hershberger, R. L. (Muenchen Univ. (F. R. Germany). Sektion Physik). Z. Phys., A; 274: No. 4, 327-334(Oct 1975).

6 figs.; 1 tab.; 15 refs.

The lifetimes have been determined for the 2^+, $0^{+\prime}$ and 4^+ states in ^{100}Mo and ^{102}Mo using the recoil-distance Doppler-shift method. The states have been excited in ^{100}Mo by Coulomb excitation and in ^{102}Mo by the two-neutron transfer reaction induced by ^{18}O ions on a ^{100}Mo target. The study of the excitation function for the elastic and inelastic scattering on the ground and first excited 2^+ state in ^{100}Mo at beam energies between 20 and 61 MeV shows that 40 MeV is the highest incident energy for pure Coulomb excitation. Above this energy nuclear absorption sets in and nuclear scattering contributes to the excitation of the 2^+ state of ^{100}Mo. From the lifetimes of the 2^+ and 4^+ states deformation parameters of absolute $\beta = 0.21$ and absolute $\beta = 0.31$ for ^{100}Mo and ^{102}Mo respectively were deduced. The $0^{+\prime}$ levels are not shape isomeric states, as suggested earlier, but the decay by enhanced E2 transitions to the first 2^+ states. From a comparison with similar states in other transitional nuclei it is suggested that they are band heads for β vibrational bands. (DE)

31802 METHOD FOR THE QUANTITATIVE ANALYSIS OF INTEGRAL SPECTRA OF $\gamma-\gamma$ COINCIDENCES. Burmistrov, V. R. Prikl. Yad. Spektrosk.; No. 5, 193-197(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

In a previous study by the method of quantitative analysis of integral anticoincidence spectra, it was pointed out that nuclear spectroscopic data on reliability of the placement of the γ transitions in the decay scheme, intensity balance for levels, the value of ϵ/β^+, and, in some cases, the total internal conversion coefficient could be obtained during quantitative analysis of the spectra of integral coincidences measured with a Ge(Li) spectrometer and NaI(Tl) crystal of small dimensions. The principles of this method are outlined and illustrated by an analysis of the decay scheme of the isomer of ^{110}Ag. (JSR)

31803 EXPERIMENTAL STUDY OF THE NUCLEAR PHYSICAL CHARACTERISTICS OF GASEOUS FISSION PRODUCTS. Kolobashkin, V. M.; Kotlyarov, A. A.; Piveen, N. S.; Khristoforov, V. A. Prikl. Yad. Spektrosk.; No. 5, 143-149(1975). (In Russian)

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

Results are reported on the experimental determination of the decay characteristics of ^{138}Xe and the probability of the population of isomeric states of ^{135}Xe. The intensity of the lines of ^{138}Xe were measured and the results given in comparison with the basic lines of ^{138}Cs. The experimental technique used to detect the ^{135}Xe isomer was described and the part of the spectrum containing the basic line of ^{135m}Xe was given. (JSR)

31804 DISCREPANCIES AMONG THEORETICAL AND EXPERIMENTAL INTERNAL CONVERSION COEFFICIENTS. Campbell, J. L.; Martin, B. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Z. Phys., A; 274: No. 1, 9-13(Aug 1975).

3 figs.; 2 tabs.; 29 refs.

A reported discrepancy of 3% between experimental K conversion coefficients for E3 and M4 transitions and those calculated by Hager and Seltzer is reduced here to a level consistent with numerical errors by using RHFS wave functions with Rosen Lindgren exchange. It is found that variation of the exchange term is insufficient to explain reported discrepancies among different calculations near threshold. Comparison of measured and calculated values near threshold indicates that present experimental data can not distinguish between the Hager and Seltzer values and those computed here. (DE)

31805 COULOMB EXCITATION OF ^{113,115}In. Tuttle, W.K. III; Stelson, P.H.; Robinson, R.L.; Milner, W.T.; McGowan, F.K.; Raman, S.; Dagenhart, W.K. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 13: No. 3, 1036-1048 (Mar 1976).

Eight states in ^{113}In and eight states in ^{115}In were observed to be Coulomb excited with α-particle and ^{16}O projectiles. Level energies, spins, B ($E2$) and B ($M1$) transition probabilities, and mean lives were obtained. The multiplet formed by $\pi g^{-1}_{9/2} \otimes 2^+_1$ (Sn) was found, and the data confirm the coupling strength to be strong. In addition, one extra $5/2^+$ and one extra $9/2^+$ level were seen in each nucleus, along with $E3$ Coulomb excitation of the $3/2^-$ levels. A firm basis for spin-parity assignments was found for all levels observed with the exception of a 1630.5 keV, $9/2^+$ level in ^{113}In. Three of the states in ^{113}In had not previously been observed in Coulomb excitation. (auth)

31806 MEASUREMENT OF THE NEUTRON DIFFERENTIAL ELASTIC SCATTERING FROM ^{90}Zr AT 2.1 AND 5.2 MeV. Stooksberry, R.W.; Anderson, J.H.; Goldsmith, M. (Westinghouse Electric Corporation, Bettis Atomic Power Laboratory, P. O. Box 79,

West Mifflin, Pennsylvania 15122). Phys. Rev. C 13: No. 3, 1061-1071 (Mar 1976).

The differential elastic neutron cross section of ^{90}Zr was measured at 2.1 and 5.2 MeV. The Bettis pulsed Van de Graaff time-of-flight system was used in conjunction with a shielded neutron detector capable of γ ray rejection by pulse shape discrimination. Identical geometry measurements made on a polyethylene sample were used for normalization of the ^{90}Zr data to the H(n,n) cross section. Comparisons were made to the results of optical model calculations. (auth)

31807 PROTON TRANSFER STUDIES OF ^{98}Tc. Martin, D.J.; Macphail, M.R. (Tandem Accelerator Laboratory, McMaster University, Hamilton, Ontario, Canada). Phys. Rev. C 13: No. 3, 1117-1122 (Mar 1976).

The doubly odd nucleus ^{98}Tc has been populated by the ^{97}Mo(^{3}He,d) and ^{97}Mo(α,t) reactions. The Q value for the former reaction has been measured to be 0.686±0.010 MeV. Angular distributions of outgoing deuterons have been measured in order to extract spectroscopic information for the levels observed. The excitation energies and extracted l values for states populated in the above reactions are as follows: 0 keV (l=4), 22(4), 67(4), 82(4), 106(4), 139(1), 202(2+4), 266, 325, 346(1), 387(4), 426(2). Tentative spin assignments have been made. (auth)

31808 MEASUREMENT OF THE 89-keV-STATE-TO-GROUND-STATE QUADRUPOLE-MOMENT RATIO IN ^{99}Ru. Kistner, O.C.; Lumpkin, A.H. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 13: No. 3, 1132-1138 (Mar 1976).

The ratio of nuclear quadrupole moments of the first excited state with respect to the ground state in ^{99}Ru has been determined from Mössbauer effect measurements with single crystal absorbers of ruthenocene. The result, $Q_1/Q_0=2.93\pm0.07$, when combined with a recent measurement of Q_0 gives the value $Q_1=0.23\times10^{-24}$ cm^2. An improved value for the $E2/M1$ amplitude mixing ratio, $\delta=-1.56\pm0.02$ is determined from magnetic hyperfine spectra obtained with an absorber of ruthenium dissolved in iron. A determination of the angle between the axis of the electric field gradient and each of the three crystal axes of ruthenocene is in good agreement with the crystal structure reported for this compound. The recoil-free fraction was found to vary with respect to orientation of the crystal axes by a factor of greater than 2. (auth)

31809 ISOMERIC 17/2$^-$ LEVEL AND PARITY MIXING IN ^{93}Tc. Brown, B.A.; Fossan, D.B.; Lesser, P.M.S.; Poletti, A.R. (Department of Physics, State University of New York, Stony Brook, New York 11794). Phys. Rev. C 13: No. 3, 1194-1199 (Mar 1976).

The ^{90}Zr(^{6}Li, 3$n\gamma$)^{93}Tc reaction has been used in conjunction with pulsed-beam γ, γ-γ coincidence, and γ angular distribution measurements to investigate a proposed $[(g_{9/2})^4 p_{1/2}]17/2^-$ isomer in ^{93}Tc. The isomeric level was found at 2185 keV on the basis of its decay properties and lifetime. The mean lifetime of the 17/2$^-$ isomeric level was measured to be $\tau=15.2\pm1.0$ μsec. The level decays by a 39.7-keV $E2$ branch (73.7±1.0%) to the 2145-keV 13/2$^-$ level and by a 750.7-keV $M2/E3$ branch (26.3±1.0%) to the 1434-keV 13/2$^+$ level. An experimental B ($E2$) [17/2$^-\rightarrow$13/2$^-$]=11.4±0.9 e^2fm^4 is obtained for the $E2$ branch, implying an effective charge of $e_p=2.49\pm0.10$. To explore possible parity mixing between the nearly degenerate 17/2$^-$ and 17/2$^+$ levels, the precise energy separation of these levels was measured to be 0.44±0.02 keV. On the basis of the observed decay properties, the parity nonconserving matrix element $\langle 17/2^+|H_{PN}|17/2^-\rangle$ was determined to be less than 0.34 eV. (auth)

31810 ON-LINE γ-γ ANGULAR CORRELATIONS OF TRANSITIONS IN ^{140}Ba. Alquist, L.J.; Schick, W.C. Jr.; Talbert, W.L. Jr.; Williams, S.A. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. C 13: No. 3, 1277-1287 (Mar 1976).

Angular correlation measurements were made on 12 direct cascades and 5 skip cascades in ^{140}Ba. Levels in ^{140}Ba were populated from the 64-sec β decay of ^{140}Cs, which was populated from the decay of ^{140}Xe. The fission-product ^{140}Xe activity was produced by the TRISTAN isotope separator system. The most intense transitions were measured in coincidence with the first-excited state-to-ground-state transition in even-even ^{140}Ba. Definite spin assignments were made for eight levels and tentative spin assignments for five levels. Values are given for the angular correlation coefficients, and multipolarity mixing ratios are listed where applicable. Systematics for N=84 isotones are discussed in light of assignments made for ^{140}Ba. (auth)

31811 PERTURBED ANGULAR CORRELATIONS. Matthias, E. (Univ., Berlin). J. Phys. (Paris); 35: No. 1, 1-2(Jan 1974).

A review is given of the method of perturbed angular correlations since its discovery in 1952 up to now. A list of selected references is provided which allows an easy and efficient access to the subject. (auth)

31812 LIFE-TIMES OF EXCITED STATES AND ANGULAR CORRELATION OF CASCADE γ RAYS FOR ^{111}Ag, ^{145}Sm, ^{151}Pm. Begzhanov, R. B.; Azimov, K. Sh.; Salimov, S. Kh.; Teshabaev, K. T. (Taskent State Univ.). Yad. Fiz.; 23: No. 1, 8-11(Jan 1976). (In Russian)

Experimental results are presented for lifetimes of excited states of ^{145}Sm and ^{151}Pm and for angular correlation of some cascade γ rays from nuclei ^{111}Ag and ^{140}Sm. (auth)

31813 EXCITATION OF ^{144}Nd BY DD NEUTRONS. Andreev, E. A.; Basenko, V. K.; Sit'ko, S. P. (Kiev State Univ.). Yad. Fiz.; 23: No. 1, 12-16(Jan 1976). (In Russian)

The electron collimation of DD neutrons with a Ge(Li) detector was used to study excited states of ^{144}Nd appeared in the (n, n'γ) reaction at E_n = 2.75 MeV. The γ spectrum was analyzed in the energy range of 250 to 2300 keV. The excitation cross sections of separate levels were estimated. The results are compared with predictions of Hauser–Feshbach–Moldauer theory. (auth)

31814 STATES IN THE N = 87 NUCLEI ^{149}Sm AND ^{151}Gd POPULATED BY THE (d,t) AND (^{3}He,α) REACTIONS. Loevhoeiden, G. (Bergen Univ. (Norway)); Burke, D. G. (McMaster Univ., Hamilton, Ontario (Canada)). Can. J. Phys.; 53: No. 12, 1182-1192(15 Jun 1975).

The (d,t) and (^{3}He,α) reactions on targets of ^{150}Sm and ^{152}Gd have been studied using a magnetic spectrograph and photographic emulsions to analyze and detect the reaction products. The (^{3}He,α) spectra were measured at two angles for each target using 24 MeV beams of ^{3}He. The ^{150}Sm(d,t)^{149}Sm reaction was studied at 13 angles with 12 MeV deuterons. The ^{152}Gd(d,t ^{151}Gd spectra were recorded at 4 angles with 15 MeV deuterons. The l values for a number of low spin states were determined from the (d,t) angular distributions. The ratios of (^{3}He,α) and (d,t) cross sections were used to obtain l values for several other states. It is possible to explain the observed strength in terms of the spherical shell model although there is fragmentation of the spherical states. One striking feature is the similarity in the structures of the two nuclei. In both ^{149}Sm and ^{151}Gd there are high spin $i_{13/2}$ states at ~0.85 MeV and $h_{11/2}$ states at ~1.25 MeV. (auth)

31815 THERMAL NEUTRON CAPTURE ON ^{142}Ce. Gelletly, W. (Schuster Laboratory, University of Manchester, Manchester, United Kingdom); Kane, W.R.; Casten, R.F. Phys. Rev. C 13: No. 4, 1434-1445 (Apr 1976).

The γ ray spectrum from thermal neutron capture on ^{142}Ce has been studied from 100 keV to 6.4 MeV. The γ rays were studied in singles and coincidence with Ge(Li) detectors. The results obtained together with information from the ^{142}Ce(d, p)^{143}Ce reaction indicate the population by neutron capture of levels in ^{143}Ce with energies 18.4 ± 0.5, 42.4 ± 0.6, (56.4 ± 1.0), 632.5 ± 0.5, 808.2 ± 0.3, 862.1 ± 0.3, 1154.1 ± 0.3, 1172.5 ± 0.3, 1572.4 ± 0.5, 1620.5 ± 0.4, 1628.7 ± 0.4, 1835.2 ± 0.8, 1913.4 ± 1.1, 1945.4 ± 0.6, 1993.3 ± 0.6, 2027.4 ± 0.8, 2061.5 ± 0.6, 2202.0 ± 0.6, 2215.9 ± 0.6, 2232.1 ± 0.7, 2272.7 ± 1.0, 2313.9 ± 0.8, 2488.6 ± 1.0, and 2537.3 ± 0.8 keV. The neutron separation energy of ^{143}Ce was determined to be 5145.9 ± 0.5 keV, which is in poor agreement with values obtained from currently available mass tables. The ^{143}Ce level scheme was found to be similar to that of other even Z, N = 85 nuclei with a small group of levels close to the ground state separated by 600–700 keV from the next level. Below 1600 keV it is possible to identify levels in ^{143}Ce excited in both the (n, γ) and (d, p) reactions. For those levels which have been assigned l_n = 1 in the (d, p) reaction, it was found that the strengths of excitation in the (n, γ) and (d, p) reactions are strongly correlated as in the neighboring N = 83 nuclei ^{139}Be and ^{141}Ce. This result is interpreted as indicating that direct capture plays an important role in the mechanism of the ^{142}Ce(n, γ)^{143}Ce reaction. (auth)

31816 REACTIONS OF 336-MeV ^{32}S WITH In. Lu, N.H.; Logan, D.; Miller, J.M. (Department of Chemistry, Columbia University, New York, New York 10027); Debiak, T.W.; Kowalski, L. Phys. Rev. C 13: No. 4, 1496-1501 (Apr 1976).

The cross section for evaporation residues produced in the complete-fusion reactions of 336-MeV ^{32}S with In has been measured. After correction for the heavy residues formed in transfer reactions, the evaporation-residue cross section is found to be 530±150 mb which corresponds to a "sharp-cutoff" angular momentum for evaporation residues of 72±9 ħ. This result is discussed in terms of various theoretical models. (auth)

31817 INELASTIC SCATTERING AND TRANSFER REACTIONS FROM ^{12}C IONS ON ^{90}Zr. Thornton, S.T.; Gustafson, D.E. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901); Ford, J.L.C. Jr.; Toth, K.S.; Hensley, D.C. Phys. Rev. C 13: No. 4, 1502-1509 (Apr 1976).

A thin ^{90}Zr target was bombarded with 98 MeV ^{12}C ions. The ^{12}C, ^{11}C, and ^{11}B reaction products were momentum analyzed in a magnetic spectrograph, and angular distributions were measured for several states in the residual nuclei. The inelastic scattering showed nuclear-Coulomb interference effects, and the distorted-wave Born approximation was used to extract deformation parameters. The transfer reaction data were analyzed with a finite range recoil distorted-wave Born-approximation

calculation. The magnitude of the deduced spectroscopic factors agreed with previous light-ion results, but the shape of the predicted angular distributions was shifted by 5° from the experimental data. (auth)

31818 LINEAR POLARIZATION MEASUREMENTS ON GAMMA RAYS FROM ^{104}Pb AND ^{106}Pd. Stromswold, D.C.; Elliott, D.O.; Lee, Y.K. (The Johns Hopkins University, Baltimore, Maryland 21218); Grau, J.A.; Samuelson, L.E.; Rickey, F.A.; Simms, P.C. Phys. Rev. C 13: No. 4, 1510-1514 (Apr 1976).

The linear polarizations of γ rays from the deexcitation of ^{104}Pd and ^{106}Pd following (heavy ion, xn) reactions were measured using a Compton polarimeter. Multipolarities for these γ rays are tabulated and level schemes are given. Polarization measurements clearly show negative parity for two major quasirotational sidebands in both ^{104}Pd and ^{106}Pd. (auth)

31819 DELAYED-NEUTRON ACTIVITIES PRODUCED IN FISSION: MASS RANGE 122–146. Lund, E.; Rudstam, G. (The Swedish Research Councils' Laboratory, Studsvik, Fack, S-611 01 Nyköping, Sweden). Phys. Rev. C 13: No. 4, 1544-1551 (Apr 1976).

Delayed-neutron emission from mass separated heavy fission products has been studied using a sensitive neutron counter. Twelve new delayed-neutron precursors have been found, namely ^{122}Ag, ^{123}Ag, ^{127}In, ^{128}Cd (or ^{128}In^{m}), ^{128}In, ^{129}In (two isomers), ^{130}In, ^{131}In, ^{132}In, ^{133}Sn, and ^{136}Sb. The half-life determination for 11 other precursors has been improved. (auth)

31820 STRUCTURE OF N=81 NUCLEI: LEVELS OF ^{141}Nd AND ^{139}Ce POPULATED IN BETA DECAY. Zalutsky, M.R.; Macias, E.S. (Department of Chemistry, Washington University, St. Louis, Missouri 63130); Meyer, R.A. Phys. Rev. C 13: No. 4, 1590-1600 (Apr 1976).

The nuclear level structure of ^{141}Nd and ^{139}Ce has been investigated by studying the decay of 20.9-min ^{141}Pm produced via the ^{141}Pr(^{3}He, 3n) reaction and the decay of 4.5-h ^{139}Pr produced by the ^{140}Pr(γ, n)^{139}Pr reaction. For the ^{141}Pm decay, singles and anti-Compton γ-ray spectra and γ-γ coincidence measurements were used to deduce a decay scheme that includes nine previously unreported levels in ^{141}Nd and incorporates 67 of the 70 γ rays attributed to the decay of ^{141}Pm. Singles and anti-Compton spectra were taken as a function of time in order to confirm assignment of the ^{139}Pr γ rays. The level structures of ^{141}Nd and ^{139}Ce are compared to recent measurements in other N=81 isotones. The results of this work are in good agreement with theoretical predictions based on the hole-vibrational coupling model for levels below 1.3 MeV. There exists more levels between 1.3 and 2.0 MeV than are predicted by this model, but these excess levels can be explained qualitatively within a weak coupling framework. (auth)

31821 ON-LINE MASS SEPARATOR INVESTIGATION OF THE NEW ISOTOPE 2.9-sec ^{116}I. Gowdy, G.M.; Xenoulis, A.C.; Wood, J.L.; Baker, K.R.; Fink, R.W. (School of Chemistry, Georgia Institute of Technology, Atlanta, Georgia 30332); Weil, J.L.; Kern, B.D.; Hofstetter, K.J.; Spejewski, E.H.; Mlekodaj, R.L.; Carter, H.K.; Schmidt-Ott, W.D.; Lin, J.; Bingham, C.R.; Riedinger, L.L.; Zganjar, E.F.; Sastry, K.S.R.; Ramayya, A.V.; Hamilton, J.H. Phys. Rev. C 13: No. 4, 1601-1608 (Apr 1976).

Using on-line mass separation ^{116}I has been identified and its half-life determined to be 2.91 ± 0.15 sec. The activity was produced by the ^{103}Rh(^{16}O, 3n)^{116}I reaction and by the decay of 57-sec ^{116}Xe. The ^{116}I decays primarily to the ground state of ^{116}Te and also to excited states at 678.9 and 1219.1 keV. From positron measurements, a decay energy of Q_{EC} = 7.71 ± 0.20 MeV is assigned to ^{116}I. γ rays of 540.2 and 678.9 keV are observed in this decay and are assigned to depopulate levels in ^{116}Te at 1219.1 and 678.9 keV, respectively. The former is a new level with a probable spin-parity of either 2$^+$ of 0$^+$. From the logft values, a spin-parity assignment of 1$^+$ is deduced for the ground state of ^{116}I, which is interpreted to have a configuration of [π ($d_{5/2}$) ν ($d_{3/2}$)]. A decay energy of Q_{EC}=4.34 ± 0.20 MeV observed from activity produced by the ^{104}Pd+^{16}O reaction is assigned to ^{116}Xe. (auth)

31822 ISOMERISM IN THE N = 81 ISOTOPE ^{147}Dy. Rainis, A.E. (University of West Virginia, Morgantown, West Virginia 26501); Toth, K.S.; Bingham, C.R. Phys. Rev. C 13: No. 4, 1609-1616 (Apr 1976).

With the use of a helium-gas-jet capillary transport system a new (59±3)-sec activity was observed in ^{14}N bombardments of ^{141}Pr. The activity was found to be associated with two coincident γ rays, 72.0 ± 0.1 and 678.7 ± 0.2 keV. The 678.7-keV transition was also observed to be in coincidence with dysprosium K x rays and its yield as a function of bombarding energy varied in the same manner as γ rays known to follow the decay of 1.9-min ^{147}Tb. From these results we conclude that the new activity is ^{147}Dy^{m} and that the 72.0- and 678.7-keV γ rays represent transitions in ^{147}Dy. Further, based on the systematic behavior of low-lying levels in N = 81 odd-A nuclei, we propose that our data establish the $h_{11/2}$ and $d_{3/2}$ neutron states in ^{147}Dy to be 750.7 and 72.0 keV, respectively, above the $s_{1/2}$ ground state. (auth)

31823 THREE-PARTICLE ONE-HOLE CONFIGURATION IN ODD-ODD ^{134}I AND THE DECAY OF ^{134}Te. Meyer, R.A.; Landrum, J.H. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550); Jackson, S.V.; Zoller, W.H.; Walters, W.B. Phys. Rev. C 13: No. 4, 1617-1623 (Apr 1976).

The levels of ^{134}I have been studied by singles and coincidence Ge(Li) spectrometers. To obtain 42-min ^{134}Te free from its daughter, 52.8-min ^{134}I, γ-γ coincidence data were taken with ^{134}Te adhered to an ion exchange column while its daughter was being continually eluted. Levels were identified at (J^{π} in parentheses) ground state (4$^+$), [44.4 (5$^+$)], 79.445 (3$^+$), 181.89 [3$^+$ (2$^+$)], 210.47 [2$^+$(3$^+$)], 645.44 (2$^+$), 846.65 (1$^+$), 923.51 (1$^+$), and 1107.44 keV (1$^+$). The levels are discussed within the framework of three-proton one-neutron-hole configurations. (auth)

31824 GAMMA-GAMMA ANGULAR CORRELATIONS IN ^{105}Rh FOLLOWING THE DECAY OF 4.4-h ^{105}Ru. Schneider, E.W.; Mathews, G.J.; Jackson, S.V.; Gallagher, P.W.; Walters, W.B. (Department of Chemistry, University of Maryland, College Park, Maryland 20742). Phys. Rev. C 13: No. 4, 1624-1629 (Apr 1976).

γ-γ angular correlations have been measured for the 349-149-, 575-149-, 393-263-, 414-263-, 350-326-, and 316-469-keV cascades in ^{105}Rh following the decay of 4.4-h 3/2$^+$ ^{105}Ru. A 3/2$^+$ spin and parity assignment is established for the 806-keV level and 1/2$^+$ or 5/2$^-$ values found consistent for the 786-keV level with 1/2$^+$ favored. For the 149-keV transition, a δ value of 0.4±0.1 is deduced. Possible configurations for the 786-keV level are discussed. (auth)

31825 LEVEL SCHEMES OF ^{91}Rb AND ^{91}Sr POPULATED IN BETA DECAY. Glascock, M.D.; Talbert, W.L. Jr. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50011); Duke, C.L. Phys. Rev. C 13: No. 4, 1630-1643 (Apr 1976).

The decays of mass-separated ^{91}Kr and ^{91}Rb have been studied using γ-ray singles and coincidence techniques. From the decay of ^{91}Kr, a level scheme is proposed for ^{91}Rb consisting of 60 excited states and accommodating 218 of the 220 observed transitions. The half-life of the 108.8-keV level of ^{91}Rb has been determined to be 0.8 ± 0.3 nsec by delayed coincidence techniques. From the decay of ^{91}Rb, 109 of the 125 observed transitions are placed in a level scheme for ^{91}Sr containing 37 excited states. The half-life of the 93.6-keV level in ^{91}Sr has been measured to be 87.4 ± 3.0 nsec. Ground-state β branching has been determined to be 10 ± 4% and 7 ± 5% for the decays of ^{91}Kr and ^{91}Rb, respectively. Some spin-parity assignments are made, and a shell-model interpretation is suggested for some of the levels. (auth)

31826 SURFACE-RESTRICTED EFFECTIVE INTERACTIONS IN A SHELL MODEL APPLICATION TO ^{88}Sr. Auerbach, N. (Department of Physics and Astronomy, Tel-Aviv University, Tel-Aviv, Israel); Vary, J.P. Phys. Rev. C 13: No. 4, 1709-1719 (Apr 1976).

We compare conventional phenomenological effective interactions acting throughout the nuclear volume with some surface restricted effective interactions for the particle-hole spectrum and properties of ^{88}Sr in a basis of neutron and proton orbitals. The surface restricted forces produce greater configuration mixing and enhance the neutron particle-hole contributions to the lowest-lying states and thus result in better agreement with experiment. (auth)

31827 NUCLEAR DECAY SCHEME STUDIES OF 30-h ^{131}Te/sup m/, 25-min ^{131}Te/sup g/, AND 55.5-min ^{105}Cd. Jackson, S. V. College Park, MD; Univ. of Maryland (1975). 399p. University Microfilms Order No. 76-3808.

Thesis (Ph. D.).

High-resolution Ge(Li) detectors have been used to observe gamma-ray singles and coincidence spectra of 30-h 11/2$^-$ ^{131}Te/sup m/, 25-min 3/2$^+$ ^{131}Te/sup g/, and 55.5-min 5/2$^+$ ^{105}Cd. Sources of ^{131}Te/sup m/ and ^{131}Te/sup g/ were produced by neutron irradiation of enriched ^{130}Te metal, and, in the case of ^{131}Te/sup m/, were chemically purified to remove the ^{131}I daughter. A total of 190 and 80 gamma-rays are attributed to the decays of ^{131}Te /sup m/ and ^{131}Te/sup g/, respectively; and 174 and 77 of these transitions have been placed in a ^{131}I level scheme involving 52 excited states. Absolute beta group intensities were determined for the transitions to ^{131}I levels. Spin and parity assignments were made for all observed levels. Sources of ^{105}Cd were produced via the ^{106}Cd(n,2n) reaction on enriched ^{106}CdO using 14 MeV neutrons. A total of 274 gamma-rays are attributed to the decay of ^{105}Cd, and 248 of these have been placed in a ^{105}Ag level scheme involving 50 excited states. Absolute values for the beta$^+$/EC transition intensities to ^{105}Ag levels were determined. Spin and parity assignments were made for all observed levels. The experimentally determined level structures of ^{131}I and ^{105}Cd are interpreted in terms of the shell model and core excitation considerations with emphasis placed on the core coupling model and the three-particle models. (Diss. Abstr. Int., B)

31828 FUTURE OF PHYSICS WITH HEAVY IONS. Stelson, P. H. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-23: No. 2, 1162-1165(Apr 1976).

From international conference on heavy ion sources; Gatlinburg, TN, USA (27 Oct 1975).

If one defines a heavy-ion "space" bounded by the three axes of mass, energy, and intensity, it becomes clear that there are large parts of this space which are completely unexplored. This, by itself, is an attractive situation since unexpected phenomena will almost certainly be found. However, it is believed that on the basis of what is already known about nuclei, atoms, and the solid state, there is ample justification to push the physics of these unexplored regions. The recent discovery that "deep inelastic scattering" as a principal reaction mechanism between two heavy nuclei was largely unexpected and this experiment will be briefly discussed. Several examples of interesting future measurements in nuclear and atomic physics with heavy-ions in the energy range of 100 MeV/AMU will be discussed.

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 28587, 30850, 31647, 31699, 31714, 31725, 31749, 31799, 31812, 31814, 31848, 31878, and 31881.

31829 (CEA-CONF-3298) PAIRING CORRELATIONS AS A FUNCTION OF NUCLEAR DEFORMATION FOR ^{152}Sm. Decharge, J.; Girod, M.; Gogny, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 9p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

Pairing effects versus deformation have been carried out for ^{152}Sm with the complete Hartree–Fock–Bogoliubov (H. F. B.) method using the effective D1 interaction. The results obtained are discussed and compared with approximations generally used to treat pairing, namely constant gap approximation and prescription of G proportional to the nucleus surface. (FR)

31830 EXPERIMENTAL EVIDENCE FOR LOW-SPIN MEMBERS OF "UPPER" UPPER BANDS IN ^{158}Dy. El Masri, Y.; Janssens, R.; Michel, C.; Monseu, P.; Steyaert, J.; Vervier, J. (Louvain in Univ. (Belgium). Inst. de Physique Corpusculaire). Z. Phys., A; 274: No. 2, 113-119(1975).

3 figs.; 1 tab.; 27 refs.

A study of the energy levels of ^{156}Dy through the ^{159}Tb(p,4n)^{156}Dy reaction has revealed the existence of six states with excitation energies between 1.8 and 2.8 MeV and spins between 6 and 12. Some of them can be tentatively interpreted as low-spin members of "upper" bands which are thought to be responsible for the backbending phenomenon experimentally observed in the ground-state and β-vibrational bands of this nucleus. Others could be levels of a negative-parity octupole band. (DE)

31831 VACUUM INSTABILITY, ANOMALOUS ASYMMETRY EFFECT, PHASE TRANSITION AND BAND MIXING IN STRONGLY DEFORMED NUCLEI. Lin, L.; Sperber, D. (Rensselaer Polytechnic Inst., Troy, NY). Lett. Nuovo Cim.; 15: No. 10, 337-342(6 Mar 1976).

It was previously suggested that the instability of the quasi-particle vacuum may be related to the high spin anomaly in rotational nuclear states and some analytical properties were discussed. The direct consequence of this fact is that the system makes a phase transition under that situation. Another theoretical fact is given supporting this phase transition by studying the induced rotational asymmetry effect. This is demonstrated by calculating the z-component of the moment of inertia. Furthermore, by combining the previous arguments it is shown that when this phase transition occurs, in order to have a proper description of the system, a modification of the physical ground state is necessary which suggests a microscopic theory of band mixing for high spin anomaly in rotational nuclear states. The x- and z-components of the moment of inertia are tabulated for ytterbium-168 and -166. (JFP)

31832 HYPERFINE INTERACTION OF ^{181}Ta IN THE COMPOUND $(Zr_{0.9}Hf_{0.1})Fe_2$. Kryukova, L. N.; Ryasnyi, G. K.; Sorokin, A. A. Prikl. Yad. Spektrosk.; No. 5, 186-192(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The perturbed angular correlation of the $\gamma-\gamma$ cascades in ^{181}Ta was studied with sources in the form of the compound $(Zr_{0.9}Hf_{0.1})Fe_2$. The angular correlations of the 133–482- and 346–136-keV cascades were first measured with liquid and non-magnetic solid sources at room temperature. For liquid samples the correlation coefficients agreed well with previous results, but there was a significant attenuation in the case of the solid. The reasons for this attenuation are considered. The integral deflection of the cascades were measured in magnetic field, and the agreement between three series was good. 4 figures, 1 table. (JSR)

31833 SHAPES OF DEFORMED NUCLEI AS DETERMINED BY ELECTRON SCATTERING: ^{152}Sm, ^{154}Sm, ^{166}Er, ^{176}Yb, ^{232}Th, ^{238}U. Cooper, T.; Bertozzi, W.; Heisenberg, J.; Kowalski, S.; Turchinetz, W.; Williamson, C. (Department of Physics and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Cardman, L.; Fivozinsky, S.; Lightbody, J. Jr.; Penner, S. Phys. Rev. C 13: No. 3, 1083-1094 (Mar 1976).

Electron scattering experiments have been performed on the deformed nuclei ^{152}Sm, ^{154}Sm, ^{166}Er, ^{176}Yb, ^{232}Th, and ^{238}U at momentum transfers between 0.5 fm^{-1} and 1.3 fm^{-1}. The cross sections for the 0^+, 2^+, and 4^+ rotational states of these nuclei have been obtained and together with other information on the electromagnetic properties of these nuclei, these data lead to information about the deformed shapes. The shapes of ^{166}Er and ^{176}Yb are quite different from the shapes of ^{152}Sm and ^{154}Sm and require a varying skin thickness. The Sm isotopes require a constant skin thickness. Results are presented for $\rho_0(r)$, $\rho_2(r)$, and $\rho_4(r)$. (auth)

31834 RESONANCE NEUTRON CAPTURE γ RAYS FROM ^{168}Er. Garg, J.B. (State University of New York, Albany, New York 12222); Cole, G.W.; Liou, H.I.; Chrien, R.E. Phys. Rev. C 13: No. 3, 1139-1144 (Mar 1976).

γ rays following neutron capture in seven major s-wave resonances in ^{168}Er up to 1 keV have been measured. The results serve to confirm and extend the knowledge of levels in ^{169}Er obtained from previous (d,p), (d,t), and thermal (n,γ) experiments. Absolute width determinations are made and a photon strength function is obtained. (auth)

31835 SYSTEMATICS OF COULOMB EXCITATION WITH LIMITED EFFECTS FROM NUCLEAR DISTORTION. Feng, D.H. (Department of Physics, University of Texas at Austin, Austin, Texas 78712); Barnett, A.R.; Goldfarb, L.J.B. Phys. Rev. C 13: No. 3, 1151-1163 (Mar 1976).

A wide-ranging survey has been made of (α,α') scattering from various target nuclei. Particular emphasis was given to determination of the departures of the cross section from Coulomb excitation, which are due mainly from nuclear interaction. The energy range in this study covers the region from the Coulomb barrier and downwards. Calculations were performed to first order only via the distorted-wave Born approximation method and the usual collective model was assumed. It is found that the inelastic scattering is more sensitive to the nuclear distortion than the elastic scattering, which conforms with results of recent experiments. A discussion is given of the Igo ambiguity in elastic and inelastic scattering near the barrier. (auth)

31836 DECAY OF ^{187}W AND THE 1/2+[411] BAND IN ODD-MASS Re ISOTOPES. Brenner, D.S. (Jeppson Laboratory, Clark University, Worcester, Massachusetts 01610); Meyer, R.A. Phys. Rev. C 13: No. 3, 1288-1294 (Mar 1976).

The γ-ray spectrum of 23.9-h ^{187}W has been measured using Ge(Li) detectors. Singles data obtained with a Compton-suppression γ-ray spectrometer and a planar Ge(Li) detector have been particularly useful in enabling us to detect very weak transitions not seen by previous experimenters. Some of these transitions have been used to establish new levels in ^{187}Re at 816.56, 826.6, 844.7, 960.17, 1190.38, and 1220.8 keV, and evidence is presented for assignment of the first four of these levels as the 5/2 1/2+[411], 7/2 1/2+[411], 7/2 7/2+[404], and 5/2 3/2+[411] Nilsson states, respectively. (auth)

31837 GAMMA-RAY ANGULAR DISTRIBUTIONS IN THE DECAYS OF POLARIZED ^{171,172}Lu. Krane, K.S. (Department of Physics, Oregon State University, Corvallis, Oregon 97331); Olsen, C.E.; Rosenblum, S.S.; Steyert, W.A. Phys. Rev. C 13: No. 3, 1295-1311 (Mar 1976).

Angular distributions of numerous γ rays have been measured following the decays of ^{171,172}Lu polarized at low temperatures. The magnetic moments of the Lu ground state are deduced to be $|\mu$ (^{171}Lu) $|= (2.03\pm0.10)$ μ_N and $|\mu$ (^{172}Lu) $|= (2.25\pm0.10)$ μ_N. Spin assignments are deduced for several levels in ^{172}Yb. $E2/M1$ and $M2/E1$ mixing ratios are deduced for many of the ^{171}Yb and ^{172}Yb transitions and are compared with expectations based on the intrinsic character of the nuclear levels. (auth)

31838 PION CAPTURE IN HEAVY NUCLEI. Locher, M. P.; Myhrer, F. (Swiss Inst. for Nuclear Research, Villigen). Helv. Phys. Acta; 49: No. 1, 123-127(1976).

The yield of neutrons from the (π^-, xn) reactions on ^{165}Ho is calculated with a two-nucleon absorption mechanism followed by (nucleon, xn) reactions using experimental input only. The comparison with the experimental yield curve supports this simple two-step model for heavy nuclei. (auth)

31839 FRAGMENTATION OF ONE-PARTICLE STATES IN DEFORMED NUCLEI. Malov, L. A.; Solov'ev, V. G. (Joint

Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 23: No. 1, 53-60(Jan 1976). (In Russian)

In framework of the model, based on the quasiparticle-photon interaction, the fragmentation of the one-particle states is studied for examples of ^{239}U and ^{169}Er. Dependence of the fragmentation on position of the one-particle level relative to the Fermi surface is studied. It is shown that in the state strength distribution in addition to the high asymmetric maximum at large excitation energies the second maximum occurs, and the distribution has a long tail. A principally new semi-microscopical method is presented to calculate the neutron strength functions, that uses the data on fragmentation of one-particle states. The following values are obtained for the strength functions: $S_0^{cal} = 1.2 \cdot 10^{-4}$, $S_1^{cal} = 2.7 \cdot 10^{-4}$ for ^{239}U and $S_0^{cal} = 1 \cdot 10^{-4}$, $S_1^{cal} = 1.2 \cdot 10^{-4}$ for ^{169}Er, that is in satisfactory agreement with the experiment. It is shown in case of ^{169}Er that if one excludes the contribution from the $4s_{\frac{1}{2}}$ subshell to the one-particle wave function then S_0^{cal} would be less by a factor of 20 and would correspond to the strength function near its minimum. (auth)

31840 A $K^{\pi} = 0^-$ OCTUPOLE BAND IN ^{150}Sm. Thompson, J. V.; Johns, M. W.; Waddington, J. C. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics). Can. J. Phys.; 53: No. 13, 1229-1235(1 Jul 1975).

A study of the ^{148}Nd(α,2n)^{150}Sm reaction has revealed the high spin states of a $K^{\pi} = 0^-$ octupole band, the members of which become the yrast levels above spin 12. γ ray angular distributions, γ-γ coincidence, and conversion electron studies have established the levels of the octupole band at 1764.6(7^-), 2232.1(9^-), 2744.0(11^-), and tentatively at 3293.0(13^-) keV. (auth)

31841 MIXED POSITIVE PARITY STATES IN ^{165}Er. Stott, W. R.; Waddington, J. C.; Burke, D. G.; Loevhoeiden, G. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics). Can. J. Phys.; 53: No. 9, 922-929(1 May 1975).

Positive parity states in ^{165}Er have been studied using the ^{167}Er(p,t)^{165}Er reaction. Two $\frac{7}{2}^+$ states at excitation energies of 63 and 465 keV were populated via $\neq 0$ transitions. Because of the lack of a pronounced minimum in the $l = 0$ angular distributions, some $l \neq 0$ strength may contribute to the population processes. Eight $l \neq 0$ transitions were seen below 1 MeV excitation energy. A description of the observed positive parity levels has been attempted in the context of a Coriolis coupled Nilsson model calculation. (auth)

31842 ELECTRONIC NUCLEAR LIFETIME EXPERIMENT FOR THE SENIOR LABORATORY. Shapiro, M.H. (Department of Physics, California State University–Fullerton, Fullerton, California 92634). Am. J. Phys. 44: No. 4, 380-383 (Apr 1976).

As part of a senior level course in nuclear laboratory techniques, the lifetime of the 482.0-keV level of ^{181}Ta has been measured by the differential coincidence method in order to illustrate some of the principles involved in a fast timing experiment. An inexpensive source for the experiment was prepared by irradiating natural hafnium metal in a neutron howitzer for a period exceeding 90 days. With simple detectors and electronics, a time resolution width of better than 3.5 nsec was obtained. Within a few lab periods the students were able to align the system and obtain a delayed coincidence time spectrum from which they were able to determine the lifetime of the 482.0-keV level to within ±15% of the accepted value, 10.8 nsec. (auth)

31843 SPECTROSCOPIC AND REACTION MECHANISM INFORMATION DERIVED FROM ^{160}Gd(*d*, *t*)^{159}Gd AND ^{162}Dy(*d*, *t*)^{161}Dy REACTION MEASUREMENTS. Peng, J.C.; Maher, J.V.; Wedberg, G.H.; Cheng, C.M. (University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 13: No. 4, 1451-1469 (Apr 1976).

Angular distributions have been measured for transitions populating residual states of ^{159}Gd and ^{161}Dy through the (*d*, *t*) reaction at E_d=17 MeV. Many of these angular distributions have shapes which are well reproduced by distorted-wave Born-approximation calculations which assume orbital angular momentum transfers *l* which are compatible with the previously assigned spin-parities of the states. But a significant number of angular distributions are anomalous; i.e., either they cannot be fitted by any reasonable distorted-wave Born-approximation calculation or they can only be fitted with a calculation which assumes an *l* value incompatible with the previous Nilsson model assignment of the state. While the summed spectroscopic factors are in good agreement with Nilsson model expectations, the spectroscopic factors for many levels deviate significantly from Nilsson model predictions—even though Coriolis coupling has been included in the model calculation. The observation of several strongly anomalous angular distributions along with some anomalous oscillatory large-angle structure in many additional angular distributions and large discrepancies between observed and model-predicted spectroscopic factors almost certainly indicates that the assumption of a simple one-step direct reaction mechanism breaks down for these reactions. (auth)

31844 DISTRIBUTION OF ELECTRICAL CHARGE IN THE NUCLEUS OF ^{181}Ta. McLoughlin, D.; Raboy, S. (Department of Physics, State University of New York at Binghamton, Binghamton, New York 13901); Deci, E.; Adler, D.; Sutton, R.; Thompson, A. Phys. Rev. C 13: No. 4, 1644-1663 (Apr 1976).

The *K* and *L* transitions of muonic atoms of ^{181}Ta were measured. A comparison of the experimental values with calculated values was made. A modified Fermi distribution of charge of three parameters was assumed for the calculation. The calculations include corrections for nuclear polarization and extended space of the Dirac hydrogenlike atom. A range of values for the half radius, the surface thickness, and the intrinsic quadrupole moment was obtained. A description of the analysis is included. (auth)

31845 ENERGY LEVEL STRUCTURES OF ^{169,170,171,172,173,174,175}Yb. Tarara, R. W. Jr. Notre Dame, IN; Univ. of Notre Dame (1976). 164p. University Microfilms Order No. 76-4614. Thesis (Ph. D.).

The energy level structures of the Ytterbium isotopes $^{169-175}$Yb were studied by means of the (d,t), (d,p), (d,d'), (p,d), and (p,p') reactions using the Notre Dame 8 MV Tandem Van de Graaf accelerator and the two broad-range magnetic spectrographs. Excitation energies were measured for 322 levels in the 0-3 MeV range of excitation. A large number of these levels have not been previously reported, some even in the 0-1.5 MeV excitation range. Many more of our measurements confirm levels previously reported but not adopted into the level schemes of these nuclei. Most of our measurements have quoted uncertainties of 0.5-2.0 keV in excitation thus providing more accurate determinations for many of the levels. Reaction cross sections are quoted for each level and for each reaction used to populate that level. Some of these cross sections are given as relative strengths compared to a particular state, while whenever possible, the cross sections were normalized to elastic scattering data and are quoted in microbarns. Complete angular distributions were taken on the ^{174}Yb(d,t)^{173}Yb and ^{172}Yb(d,p)^{173}Yb reactions at a deuteron energy of 14 MeV using position sensitive proportional counters mounted at the focal surface of the 100-cm spectrograph. These distributions were compared to predictions of DWBA theory to determine l-values. Many tentative assignments were confirmed and 9 new l-values are assigned. These new assignments fix the parities for the states involved. In several cases no unique l-assignment could be made but the choice of possible values could be limited. Spectroscopic factors were calculated for all the measured states using the different j-values associated with the assigned or possible l-values. The results of our work on ^{173}Yb are compared to the proposed level scheme and band structure for this nucleus. A number of possible placements of levels for which we assign l-values are made. (Diss. Abstr. Int., B)

31846 ^{165}Ho(n, gamma) STANDARD CROSS SECTION FROM 3 TO 450 keV. Macklin, R. L. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 59: No. 3, 231-236(Mar 1976).

The ^{165}Ho(n, gamma) cross section was measured at the Oak Ridge Electron Linear Accelerator neutron time-of-flight facility. Nonhydrogenous scintillation detectors were used with pulse-height weighting to measure the prompt photon yield, normalized to the saturated 3.92-eV resonance in (^{165}Ho + n) and the shape of the ^{6}Li(n, alpha) cross section. Resonance parameters for many of the observed peaks below 3 keV were determined by a non-linear least-squares fit. The data to 100 keV were well fitted with energy-independent strength functions 10^4S^0 equals 1.33 +- 0.14, 10^4S^1 equals 1.36 +- 0.24, 10^4S_2 equals 1.19 +- 0.76 and anti GAMMA/sub gamma/D_0 equals 0.076/(3.23 +- 0.55 eV). The fluctuations of the cross section about the strength function fit are analyzed for 250-eV averages. The Wald-Wolfowitz "Runs" test is consistent with no additional nonrandom structure in the cross section. 3 figures, 1 table. (auth)

31847 NON-ADIABATIC EFFECT ON THE COLLECTIVE G-FACTOR AND THE K-FORBIDDEN M1 TRANSITION IN ^{166}Er. Ikegami, H.; Morinobu, S.; Katayama, I.; Miyokawa, T. Bull. Inst. Chem. Res., Kyoto Univ.; 52: No. 1, 132-136(Jul 1974).

The I-dependence of the reduced spin rotation g/Q_0^2 was observed for the ground-state rotational band of ^{166}Er. The M1-admixture in the interband K = 2 — K = 0 transition was found to be three order of magnitude larger than that expected from the direct band-mixing theory. These facts show that the role of the mixing of states with K = 1 (the core polarization) and/or the Coriolis anti-pairing are of particular importance in the magnetic properties of the collective states. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 30850, 31699, 31714, 31740, 31749, 31755, 31759, 31833, 31835, 31880, 31881, and 31916.

31848 (JINR-P4-9279) INFLUENCE OF HIGHER COMPONENTS IN α-PARTICLE INTERNAL FUNCTION ON α-TRANSITION PROBABILITIES IN SPHERICAL NUCLEI. Kholan, S.; Furman, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 18p. (In Russian). (CONF-760115-1). Dep. NTIS (US Sales Only) $3.50.

From 26th all-union conference on nuclear spectroscopy and structure of atomic nuclei; Baku, Union of Soviet Socialist Republics (USSR) (Jan 1976).

Formulas are derived to consider higher configurations of the internal α-particle wave function in α-widths calculations. Some numerical calculations of α-widths are performed for harmonic oscillator shell model basis using a phenomenological form of the α-particle internal wave function which fits its charge form-factor. The results of these calculations indicate that the account for higher configurations may appreciably influence the relative and absolute values of α-widths. (auth)

31849 (JINR-R-1-7475) SEARCH FOR TETRANEUTRONS IN REACTIONS OF π^--MESON DOUBLE CHARGE EXCHANGE ON HEAVY NUCLEI. Batusov, Yu. A.; Ganzorig, Zh.; Gumnerova, L.; Dudova, I. V.; Sidorov, V. M.; Khalkin, V. A.; Chultehm, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 11p. (In Russian). INIS.

31850 EXCITED STATES IN ^{199}Bi, ^{201}Bi, ^{203}Bi ISOTOPES. Korman, A.; Chlebowska, D.; Kempisty, T.; Chojnacki, S. (Univ., Warsaw). Acta Phys. Pol., Ser. B; B7: No. 2, 141-157(Feb 1976).

The β^+-EC decays of isomeric and ground states in ^{199,201,203}Po isotopes, produced in heavy ion reactions have been investigated. On the basis of the single γ-spectra, γ-γ coincidence and conversion electron measurements, the levels in ^{199,201,203}Bi isotopes are presented. The experimental data and the results of theoretical calculations are compared. (auth)

31851 ENERGY DEPENDENCE OF DEEPLY INELASTIC SCATTERING OF ^{84}Kr FROM ^{208}Pb. Vandenbosch, R.; Webb, M.P. (University of Washington, Seattle, Washington 98195); Thomas, T.D. Phys. Rev. Lett. 36: No. 9, 459-462 (1 Mar 1976).

The angular distribution for deeply inelastic scattering of ^{84}Kr from ^{208}Pb at laboratory energies of 494, 510, and 718 MeV exhibits a strong peak that moves forward and sharpens with increasing energy. Forward peaking never becomes prominent. The integrated cross section is nearly equal to the total absorption cross section at all energies. These results are inconsistent with a unique critical radius for fusion and are in contrast to those for systems with lower Z_1Z_2 product. (auth)

31852 NORMALIZED SHELL MODEL ALPHA DECAY THEORY APPLIED TO UNFAVORED DECAY. Fliessbach, T.; Mang, H.J.; Rasmussen, J.O. (Lawrence Berkeley Laboratory, Berkeley, California 94720). Phys. Rev. C 13: No. 3, 1318-1323 (Mar 1976).

A shell model α-decay theory is presented which uses correctly antisymmetrized and normalized wave functions. Numerical calculations are performed for the α-decay constants for unfavored decay of ^{211}Po and ^{211}Bi and for hindrance factors of excited ^{212}Po states. The results are compared with those of the conventional shell model α decay theory. (auth)

31853 RADIOCHEMICAL STUDY OF ALPHA PARTICLE EMISSION IN REACTIONS OF ^{202}Hg WITH 10-86 MeV PROTONS. Kantelo, M.V.; Hogan, J.J. (Department of Chemistry, McGill University, Montreal, Quebec, Canada). Phys. Rev. C 13: No. 3, 1095-1103 (Mar 1976).

Excitation functions have been measured for ^{202}Hg(p,2pxn), x=0-9, reactions induced by protons of energy 10-86 MeV. Reactions having $x>1$ exhibit two peaks in their excitation functions, the first below the energy calculated for emission of the individual nucleons. This peak is attributed to emission of an α particle. A procedure is proposed for decomposing the excitation functions into two components, one arising from α particle emission, the second from emission of individual nucleons. From these, the total yield of α particles as a function of incident energy is determined, and the excitation energy spectra associated with α emission events is deduced. The α particle yields are attributed to more than one mechanism; speculations are advanced on a substantial pre-equilibrium evaporation component to the total α particle production. (auth)

31854 ON THE SPIN ASSIGNMENT TO THE 268 keV STATE IN Au^{197}. Bikit, I. S. (Novi Sad Univ. (Yugoslavia). Faculty of Sciences); Anicin, I. V. (Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia)). Z. Phys., A; 274: No. 1, 69-71 (Aug 1975).

2 figs.; 3 tabs.; 18 refs.

It is shown that the recent internal conversion data favour the $I = 1/2$ value if the penetration effects in M1 conversion are fully taken into account. The 191 keV transition is found to be an M1 + E0 mixture with 41(2)% E0, although the measured K conversion coefficient is smaller than the theoretical $\beta_{(K)(M1)}$ value. (DE)

31855 MULTIPLICITY DISTRIBUTION OF NEUTRONS IN PION CAPTURE BY LEAD NUCLEI. Buttsev, V. S.; Vandlik, Ya.; Vylov, Ts.; Ganzorig, Zh.; Gumnerova, L.; Zaitseva, N. G.; Polikanov, S. M.; Savchenko, O. V.; Chultem, D. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 23: No. 1, 17-29(Jan 1976). (In Russian)

It is shown for the first time that neutron-deficient isotopes lying considerably far from the β-stability band are produced in the capture of negative pions by heavy nuclei. A broad distribution (from 4 to 11) of emitted neutrons is observed by the yield of thallium isotopes produced in the Pb (π^-, xn) reaction. Intensive excitations of high spin states of ^{198m}Tl(7$^+$) and ^{198m}Tl(7$^+$) are found in π^- meson capture by lead nuclei. An unusually large isomeric ratio $\xi = \sigma_m/\sigma_g = 5.0$ is found in ^{198}Tl.

31856 G-FACTOR OF THE METASTABLE 6 $^3P_0$ LEVEL OF ODD ISOTOPES OF MERCURY. Lahaye, B.; Margerie, J. (Caen Univ., 14 (France)). J. Phys. (Paris); 36: No. 10, 943-952(Oct 1975).

The paramagnetic correction to the g-factor of the 6 $^3P_0$ level of odd isotopes of mercury has been computed. The values of $^{199}g(6\ ^3P_0)$ and $^{201}g(6\ ^3P_0)$ have been calculated only with an accuracy of the order of one percent, because of uncertainties in the hyperfine coupling theory for the 6s 6p configuration of mercury. On the other hand, the ratio $^{201}g(6\ ^3P_0)/^{199}g(6\ ^3P_0)$ has been predicted with much higher accuracy to be −0.369 414(16). From optical pumping of the 6 $^3P_0$ level in mercury vapor, in presence of a few torr of nitrogen, the experimental values of the same parameters have been determined: $^{199}g(6\ ^3P_0) = -0.950\ 4(4) \times 10^{-3}$; $^{201}g(6\ ^3P_0) = 0.351\ 08(7) \times 10^{-3}$; $^{201}g(6\ ^3P_0)/^{199}g(6\ ^3P_0) = -0.369\ 41(8)$, significantly improving previous experimental results obtained by one of us. The new observed values are in perfect agreement both with the previous ones and with the theoretical predictions. (FR)

31857 STUDY OF THE REACTION ^{209}Bi + ^{136}Xe. Schröder, W.U.; Birkelund, J.R.; Huizenga, J.R. (Departments of Chemistry and Physics, University of Rochester, Rochester, New York 14627); Wolf, K.L.; Unik, J.P.; Viola, V.E. Jr. Phys. Rev. Lett. 36: No. 10, 514-517 (8 Mar 1976).

The charge, kinetic energy, and angular distributions of reaction products formed during bombardment of ^{209}Bi with 1130-MeV ^{136}Xe ions have been studied in detail. The measured total direct-reaction cross section of 2840±150 mb is in good agreement with the total reaction cross section obtained by analysis of the elastic-scattering distributions. The principal reaction channel is observed to be due to the strongly damped collision mechanism. (auth)

31858 ELASTIC ELECTRON SCATTERING FROM THE *M*7 AND *M*9 MAGNETIZATION DENSITY OF ^{209}Bi. Moreira, J.R.; Nascimento, I.C. (Instituto de Fisica, Universidade de São Paulo, São Paulo, Brazil); Arita, K.; Friedrich, J.; Enomoto, A.; Terasawa, T.; Torizuka, Y. Phys. Rev. Lett. 36: No. 11, 566-569 (15 Mar 1976).

Electron scattering cross sections have been measured at backward angles and momentum transfers where the *M*7 and *M*9 form factors are dominant. The measured cross sections are consistent with those predicted by single-particle calculations, and are reasonably reproduced by calculations which take into account the core-polarization effects required to explain the *M*1 and *M*3 moments. (auth)

31859 REACTION MECHANISM STUDIES WITH ^{4}He IONS AND HEAVY TARGET NUCLEI. Meyer, W. G. College Park, MD; Univ. of Maryland (1975). 171p. University Microfilms Order No. 76-3813.

Thesis (Ph. D.).

Reaction mechanism studies were performed on the ^{4}He + ^{233}U system at ^{4}He ion energies of 28–140 MeV and on the ^{4}He + ^{209}Bi system at energies of 69.2 and 140 MeV. Measurements included: (1) elastic scattering, (2) fission-fragment angular distributions, (3) total fission cross sections, and (4) complete-fusion probabilities. Nuclear reaction cross sections, sigma/sub R/, were determined from the elastic scattering data. These cross sections were compared with the ^{4}He + ^{233}U total fission cross sections, sigma/sub f/, to test the assumption that sigma/sub R/ approximately equal to sigma/sub f/ for this system and good agreement was found. An empirical relationship is presented for estimating sigma/sub R/ for reactions of ^{4}He- and heavy-ions with heavy target nuclei. The fission-fragment angular correlation technique was used to determine the complete-fusion probability. These measurements show that the probability for complete-fusion decreases from 72 percent to 54 percent over an energy range of 49.0 to 140 MeV for the ^{4}He + ^{233}U system. The complete-fusion probabilities are compared with various models used to predict complete-fusion cross sections for systems of heavy-ion pro-

jectiles and heavy target nuclei. For systems of ^{4}He ions and heavy target nuclei, calculated complete-fusion probabilities are considerably larger than experimentally determined values. Angular distribution measurements are interpreted in light of the reaction mechanism studies of this work. Conclusions are drawn as to the validity of using intermediate energy (E greater than or approximate to 40 MeV) ^{4}He ions for investigating fission phenomena; especially where a detailed knowledge of the excitation energy and angular momentum distribution is necessary for accurate interpretation of such phenomena. (Diss. Abstr. Int., B)

31860 SPECTRA OF BREMSSTRAHLUNG PRODUCED IN VERY THICK LEAD TARGETS BY 15-, 20-, AND 25-MeV ELECTRONS. Nakamura, T. (Inst. for Nuclear Studies, Tanashi, Japan); Kirayama, H. Nucl. Sci. Eng.; 59: No. 3, 237-245(Mar 1976).

The spectra of bremsstrahlung from very thick lead targets bombarded by 15-, 20-, and 25-MeV electrons from a linear accelerator were measured with activation detectors. This activation method has the advantage of being available for measuring the spectrum of a bremsstrahlung burst and being suitable for determining the distribution of the photon energy spectrum in the medium. By use of the most accurate photonuclear cross section data available, the bremsstrahlung spectra were evaluated with the LYRA unfolding code. The evaluated spectra were in good agreement with the calculated spectra, especially at 9 deg for 15- and 20-MeV electrons. It is concluded that the spectrometry of bremsstrahlung radiation by activation detectors can satisfactorily represent the variation of bremsstrahlung spectrum as a function of incident electron energy. The spectra obtained by this method are very much dependent on the photonuclear cross section data of activation detectors. This activation experiment can be used as an integral experiment to evaluate photonuclear cross section data by coupling with the reference calculations. 4 tables, 7 figures. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 28432, 28587, 31749, 31754, 31791, 31833, 31835, 31839, 31859, 32453, and 32464.

31861 (CEA-CONF-3180) HIGH RESOLUTION MEASUREMENT OF FISSION CROSS SECTIONS FOR ^{239}U AND ^{239}Pu RELATIVE TO ^{235}U. Blons, J.; Mazur, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1975. 11p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

Ratios of the neutron induced fission cross section of ^{238}U and ^{239}Pu relative to ^{235}U were measured with a gas scintillator at the 60 MeV Saclay linac up to 5 MeV Below the fission threshold of ^{238}U intermediate structures are observed. Due to the good energy resolution some structures appear between 300 keV and 1200 keV for ^{238}U and up to 1 MeV for ^{239}Pu. (FR)

31862 (CEA-CONF-3181) DISPLAY OF ROTATIONAL LEVELS NEAR THE FISSION THRESHOLD IN ^{232}Th(n,f) REACTION. Blons, J.; Mazur, C.; Paya, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1975. 10p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

The ^{232}Th(n,f) cross section has been measured relative to that of ^{235}U up to 5 MeV, with a neutron energy resolution of 3 keV at 1.6 MeV. The angular anisotropy of fission fragments has also been measured in the same energy range with an energy resolution of 6 keV at 1.6 MeV. The broad vibrational levels located above 1 MeV are resolved into sharp structures which are interpreted as rotational states. The rotational constants $\hbar^2/2J$ of highly deformed ^{233}Th are found to be 2.45 and 2.65 keV at 1.5 and 1.6 MeV respectively. These results are interpreted by the possibility of a third minimum in the fission barrier. (FR)

31863 (CEA-CONF-3182) FISSION CROSS SECTIONS AND RESONANCE PARAMETERS FOR ^{241}Am. Lucas, B.; Derrien, H.; Paya, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1975. 15p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

The analysis of the total cross section of ^{241}Am has provided the resonance parameters up to 150 eV. A measurement of the fission cross section has been performed using a fast neutron detector. The fission widths can be extracted from this cross section up to 40 eV. The results are compared with those calculated from other laboratories' data. (FR)

31864 (CEA-CONF-3183) FISSION CROSS SECTION MEASUREMENT FOR ^{237}Np BETWEEN 100 keV AND 2 MeV. Plattard, S.; Pranal, Y.; Blons, J.; Mazur, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France); CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. de Recherche et Analyse). 1975. 9p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

High resolution neutron-induced fission cross section measurements in the threshold region for several actinides have been undertaken at the 60 MeV linac of Saclay used as a pulsed neutron source. The time of flight spectrometer has a nominal resolution of 0.3 ns/m. In this paper, the results of ^{237}Np between 100 keV and 2 MeV are presented which confirm the low value of the energy of the second minimum of the ^{238}Np double-humped fission barrier. Because of the complete damping of possible vibrational states in the second well of such a fission barrier, no vibrational resonances have been observed in the threshold region. (FR)

31865 (CEA-CONF-3299) STATISTICAL MODEL EVALUATION OF (n,xn) AND (n,xnf) CROSS SECTIONS FOR HEAVY NUCLEI. Jary, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 13p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

A method for a statistical model evaluation of fission, (n,2n) and (n,3n) cross sections from 2 MeV to 20 MeV neutrons on ^{237}U, ^{238}U, ^{239}U and ^{239}Pu is presented. It consists of the determination of fission width parameters by a fit to known fission cross-sections. This method makes use of neutron transmission coefficients from an adapted coupled channel model. The neutron, fission and radiative widths are calculated by the statistical model including Fermi gas model level densities. Results are given for ^{237}U, ^{238}U, ^{239}U, and ^{239}Pu nuclei. (FR)

31866 (CEA-CONF-3301) EVALUATION OF A COHERENT SET OF CROSS SECTIONS FOR n+^{238}U BETWEEN 3 keV AND 20 MeV BY NUCLEAR MODELS. Jary, J.; Lagrange, C.; Thomet, P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 23p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

A method for an optical and statistical model evaluation of a coherent set of neutron cross sections on ^{238}U from 3 keV to 20 MeV is presented. It is shown that a satisfying determination of various cross sections can be obtained from an adequate adjustment of the models on some experimental data. (FR)

31867 (CEA-CONF-3308) (n,γf) REACTION STUDY FOR THE ^{241}Pu FISSION INDUCED BY RESONANCE NEUTRONS. Simon, G.; Frehaut, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 12p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

Fluctuations from resonance to resonance of the average number of prompt neutrons and of the average gamma ray energy have been measured for the neutron-induced fission of ^{241}Pu in the energy range 4–91 eV. The 60 MeV linear accelerator of CEN Saclay was used to produce the pulsed beam of incident neutrons, and a large Gd-loaded liquid scintillator to measure simultaneously the average number of prompt neutrons and the average gamma ray energy. Weak anticorrelated fluctuations observed for these two quantities have been attributed to the (n,γf) reaction. (FR)

31868 (CEA-CONF-3309) ENERGY SPECTRUM MEASUREMENT OF FISSION NEUTRONS FOR ^{235}U AND ^{238}U FISSION INDUCED BY 0.6 MeV AND 7 MeV NEUTRONS. Bertin, A.; Bois, R; Frehaut, J; Nicolas, P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 12p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

The prompt fission neutron energy spectrum of ^{235}U has been measured at an incident neutron energy of 0.60 MeV using the sample and the fission chamber methods. For the two experiments the spectrum has been measured at 90° using time of flight technique. The results obtained are equivalent for both methods. The fission chamber technique has been used to give simultaneous measurements on ^{235}U and ^{238}U at an incident neutron energy of 7 MeV. For all these measurements, the spectrum in the fission neutron energy interval from 1 to 10 MeV has been least-square fitted with a maxwellian distribution. (FR)

31869 (CEA-CONF-3310) PREFISSION GAMMA RAY SPECTRUM OF THE $^{239}Pu(n,\gamma f)$ REACTION INDUCED BY RESONANCE NEUTRONS. Trochon, J.; Pranal, Y.; Simon, G.; Suskod, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 14p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

After the experimental evidence for a $(n,\gamma f)$ reaction induced by resonance neutrons in the ^{239}Pu, a theoretical and experimental study of the prefission γ ray spectra has been performed. The calculations of the GAMMA(γf) width and of the prefission γ-ray spectrum has been done in terms of the double humped fission barrier, including the damping of the vibrational states in the second well. The prefission γ-ray spectrum measurement is presented. All the results are discussed. (FR)

31870 (CTOM-16919) STUDIES IN THE DECAY OF ^{235}U, ^{231}Th AND ^{231}Pa: THE FIRST THREE MEMBERS OF THE ACTINIUM SERIES. Teoh, W. (Manitoba Univ., Winnipeg (Canada)). 1973. 194p. INIS.

Microfiche only.

The decays of ^{231}Pa, ^{231}Th and ^{235}U have been determined experimentally, using high resolution semi-conductor gamma ray detectors. A computer program, CUTIPIE, was developed to analyze the spectra. CUTIPIE utilizes a numerical second difference method for automatic peak searching, and a non-linear, multiparameter, iterative least squares procedure for peak fitting. Of 73 gamma rays observed in the ^{231}Pa decay, three (161.0, 228.0, and 427.0 keV) have not been previously reported and these were observed only in coincidence experiments. Conversion electrons were examined using a trochoidal spectrometer. The K conversion coefficients of 11 transitions were determined and of these, two (α_K of the 243.15 and 255.10 keV) had not been reported previously. The coefficients were determined to be 0.54 ± 0.14 and 0.21 ± 0.05 respectively. All but one of the 73 gamma rays were placed in the decay scheme and three new levels (429.6, 457.7 and 641.0 keV) were suggested. Following beta decay of ^{231}Th seven new transitions were observed in gamma-gamma coincidence measurements and their energies determined (44.2, 45.8, 47.2, 71.8, 73.23, 104.1 and 115.9 keV). Of 48 gamma rays observed, all but two (45.8 and 114.8 keV) were placed in the decay scheme. One new level (294.5 keV) was suggested. Of 28 gamma rays associated with decay of ^{235}U, 11 new transitions were observed. Three new levels (390.27, 317.42 and 240.82 keV) were suggested.

31871 (FRNC-TH-584) MEASUREMENT OF MASS AND CHARGE DISTRIBUTIONS IN MEAN ENERGY FISSION USING AN EMANATION METHOD. Feu Alvim, C. (Grenoble-1 Univ., 38 (France)). 1975. vp. (In French). INIS.

An experimental procedure for measuring the charge distribution of fission fragments using a gamma detection method was developed, with special reference to the charge distribution after prompt gamma and neutron emission. The method was then applied to two fission producing systems (^{238}U+n at 14 MeV) and (^{232}Th+n at 14 MeV). Although the results obtained cover a limited fission product region they supply interesting information on the phenomenon of 14 MeV neutron-induced fission. When directly linked with those of measurements performed with the separator ARIEL they provide experimental values for the fractional cumulative yields of rare gases and halogens, the relative chain yields, the parameters $\sigma(n)$ and $\sigma(Z)$ associated with the yield curve widths at constant A or Z (Wahl Gaussians), the most probable charges and the number of neutrons emitted (^{232}Th). By adding an external normalization factor it was also possible to give values for the chain yields and for the elementary yields. Irregularities are shown in the fractional cumulative yields, apparently connected with the characteristics of the fragments formed (probably neutron emission) since they are found in both thermal neutron and 14 MeV neutron-induced fission. Pairing effects and the structure observed for the most probable charge deviations with respect to $Z_{(U.C.D.)}$ (U.C.D. = unchanged charge distribution) seem not to disappear with the increase in excitation energy as would be expected from the explanations generally put forward for these phenomena. (FR)

31872 (LBL-4346) BERKELEY NEW ELEMENT PROGRAM. Ghiorso, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-ENG-48. 16p. (CONF-750938-3). Dep. NTIS $3.50.

From seminar on reactions of heavy ions with nuclei and synthesis of new elements; Dubna, USSR (23 Sep 1975).

The work done with element 106 is reviewed, and a new experiment which bears on the properties of the isotope of mass 260 with atomic number 104 is discussed. It is noted that in the case of element 106 a link is demonstrated to the granddaughter as well as the daughter. (JFP)

31873 (ORNL/TM-5223) SUR, A PROGRAM TO GENERATE ERROR COVARIANCE FILES. Difilippo, F. C. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 47p. Dep. NTIS $4.50.

Covariance matrices were calculated for the ^{238}U, ^{241}Pu, and ^{239}Pu fission cross sections and for the ^{238}U, ^{240}Pu, ^{241}Pu, and ^{239}Pu capture cross sections. A computer program was written which uses the evaluated ENDF/B data files and the measured or evaluated (from other evaluations) cross sections for the calculation of the uncertainty files. An effort has been made to make the output of the program consistent with the ENDF/B error files format. A user's manual for the present code and references utilized in the covariance matrix calculations are given. (auth)

31874 (ORNL/TM-5256) MEASUREMENT OF NEUTRON TRANSMISSIONS FROM 0.52 eV TO 4.0 keV THROUGH SEVEN SAMPLES OF ^{238}U AT 40 m. Olsen, D. K.; de Saussure, G.; Perez, R. B.; Silver, E. G.; Ingle, R. W.; Weaver, H. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 117p. Dep. NTIS $7.00.

Neutron transmissions through 1.5-, 5-, 10-, 30-, 100-, 425-, and 1425-mil samples of depleted ^{238}U were measured from 0.52 eV to 4.0 keV using the ORELA pulsed electron linac neutron source and time-of-flight technique with a 1-mm ^{6}Li-glass detector with a flight path of 40 m. The measurements are tabulated and compared with transmissions calculated from the ENDF/B-IV total cross section. In addition, the 1425-mil transmission from 50 to 300 eV is compared with transmissions calculated by using multilevel formalisms, and some neutron widths are extracted with area analysis and compared with those from previous measurements. 14 figures, 10 tables. (auth)

31875 ABSOLUTE YIELDS OF ^{99}Mo IN THE THERMAL NEUTRON-INDUCED FISSION OF ^{233}U AND ^{239}Pu. Egger, C.; von Gunten, H. R. (Bern Univ. (Switzerland). Anorganisch-Chemisches Inst.); Schmid, A.; Pruys, H. S. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Radiochim. Acta; 21: No. 3/4, 200-202(1974).

3 tabs.; 17 refs.

Absolute yields of ^{99}Mo were redetermined in the thermal neutron-induced fission of ^{233}U and ^{239}Pu. $(4.75 \pm 0.11)\%$ and $(6.22 \pm 0.14)\%$ were obtained, respectively, for the yields of ^{233}U and ^{239}Pu. (DE)

31876 TERNARY FISSION OF URANIUM INDUCED BY 414 MeV Ar-IONS AS STUDIED WITH A HOLE DETECTOR. Vater, P.; Brandt, R. (Marburg Univ. (F. R. Germany). Fachgebiet Kernchemie). Radiochim. Acta; 21: No. 3/4, 191-195(1974).

7 figs.; 1 tab.; 15 refs.

The ratio of ternary fission to binary fission is determined to be $(2.4 \pm 1.0\%)$ in the interaction of uranium with 414 MeV Ar-ions. The results are obtained by applying a new experimental technique: the hole detector in mica as suggested by Starke. This new technique is tested with binary fission of natural uranium, induced with thermal neutrons. Furthermore, some angular distributions of fission fragments are measured and some recent theoretical developments are discussed in a qualitative manner. (DE)

31877 SUBCOULOMB STRIPPING AND PICKUP REACTIONS ON ^{238}U. Gareev, F. A.; Schul'ts, G.; Yamaleev, R. M.; Puzynin, I. V.; Puzynina, T. P.; Kukhtina, I. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 6, 1136-1141(Dec 1975). (In Russian).

The subcoulomb reactions $^{238}U(d, p)^{239}U$ and $^{238}U(d, t)^{237}U$ were analyzed at incident energies of the deutrons from 8 up to 12 MeV by means of a coupled channel calculation. Results obtained show that with respect to the simple DWBA the inclusion of inelastic processes in both the initial and exit channel improves the description of the functional behavior of the cross sections and the dependence on E_d. (auth)

31878 STUDY OF THE KX RADIATION DURING IRRADIATION OF SOLID TARGETS WITH XENON IONS AT 150 MeV. Gippner, P.; Kaun, K. G.; Noibert, V.; Stari, F.; Shul'tse, V. Prikl. Yad. Spektrosk.; No. 5, 155-158(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

For explanation of some singularities of the ionization process of the internal electron shell during collisions of heavy ions with atoms, two models have been proposed: model of direct ionization by Coulomb excitation and the quasimolecule model. Thick metallic targets were irradiated with 150-MeV ^{136}Xe ions and K_α and K_β radiation was measured as a function of the atomic number of the target. The results were analyzed on the basis of the two models. (JSR)

31879 RECOIL DISTANCE LIFETIMES OF ROTATIONAL STATES IN ^{236}U. Guidry, M.W.; Sturm, R.J.; Johnson, N.R.; Eichler, E.; O'Kelley, G.D.; Singhal, N.C.; Sayer, R.O. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 13: No. 3, 1164-1172 (Mar 1976).

Half-lives for members of the ^{236}U ground-state rotational band have been measured by the recoil-distance method following Coulomb excitation with $^{40}Ar^{8+}$ projectiles. The $B(E2, I \rightarrow I-2)$ values in units of e^2b^2 determined from the half-lives of the 4^+, 6^+, 8^+, 10^+, and 12^+ states are 3.03 ± 0.20, 3.28 ± 0.19, 3.42 ± 0.28, 3.11 ± 0.30, and $3.34^{+2.23}_{-0.95}$, respectively. Transition quadrupole moments $Q_0(I_i \rightarrow I_f)$ deduced from the lifetimes are constant within experimental error and thus support the characterization of ^{236}U as a good rotor to spin 12^+. (auth)

31880 NEW EXPANSION FOR HIGHLY ANISOTROPIC NEUTRON-NUCLEUS SCATTERING. Attia, E. A.; Harms, A. A. (McMaster Univ., Hamilton, Ont.). Nucl. Sci. Eng.; 59: No. 4, 319-325(Apr 1976).

A new representation of scattering kernels particularly appropriate for highly anisotropic scattering is investigated. It is found that the partial-range orthogonal function representation developed here can conveniently avoid the traditional problem of "negative fluxes" while retaining a high directional accuracy for even extreme cases of anisotropy. 7 figures, 1 table. (auth)

31881 NEUTRON CAPTURE CROSS SECTIONS FROM 0.1 TO 3 MeV BY ACTIVATION MEASUREMENTS. Lindner, M.; Nagle, R. J.; Landrum, J. H. (Univ. of California, Livermore). Nucl. Sci. Eng.; 59: No. 4, 381-394(Apr 1976).

Neutron capture cross sections for ^{238}U, ^{237}Np, ^{232}Th, ^{197}Au, ^{193}Ir, ^{191}Ir, ^{187}Re, ^{185}Re, ^{186}W, ^{181}Ta, and ^{114}Cd relative to the ^{235}U fission cross sections have been determined for neutron energies from 120 keV to 2.9 MeV by the measurement of the activation products. Neutrons were produced by the ^{3}H(H,n)^{3}He reaction on tritium gas targets on the Los Alamos Scientific Laboratory vertical Van de Graaff accelerator. Metal foils were exposed at selected angles and distances from the neutron source to achieve a selection of neutron energies. Neutron fluxes were measured with ^{235}U fission detectors placed at various angles for different proton energies. Scattering corrections were applied to the experimental results through the use of Monte Carlo computer simulation techniques. Corrections were also calculated for the purely geometrical effects on energy resolution due to finite source and sample width and thickness. 6 tables, 16 figures. (auth)

31882 ENERGY SPECTRA OF SECONDARY NEUTRONS FROM THE ^{238}U(n,2n) AND (n,3n) REACTIONS. Caner, M. (Soreq Nuclear Research Center, Yavne, Israel); Segev, M.; Yiftah, S. Nucl. Sci. Eng.; 59: No. 4, 395-405(Apr 1976).

A consistent compound nucleus theory of (n,2n) and (n,3n) neutron emission was applied to ^{238}U to obtain the energy spectra of the second and third secondary neutrons. The evaluation was based on inelastic level excitation and evaporation data for ^{238}U, ^{237}U, and ^{236}U. The ^{238}U and ^{236}U data were retrieved from ENDF/B-IV files; the ^{237}U data were evaluated in the Soreq Nuclear Research Center using experimental information and statistical reaction theory codes. At reaction energies E_0 just above the (n,2n) threshold energy B_2, the energy E of the second inelastic neutron has a spectrum of $(E_0 - B_2 - E)$; above the (n,3n) threshold, B_3, the third neutron energy has a spectrum of $(E_0 - B_2 - E)^3$. At energies E_0, high above the thresholds, the second and third neutron spectra approach the evaporation form. A secondary neutron spectrum for any given reaction energy E_0 is approximated by a composite form for which the temperatures and blending coefficients were evaluated for several energies in the range from threshold up to 15 MeV. 6 figures, 3 tables. (auth)

31883 POLARIZABILITY OF NUCLEAR MATTER IN FISSILE NUCLEUS AND CHARGE DISTRIBUTION OF FISSION FRAGMENTS. Adeev, G. D.; Filipenko, L. A.; Cherdantsev, P. A. (Inst. of Nuclear Physics, Tomsk, USSR). Yad. Fiz.; 23: No. 1, 30-43(Jan 1976). (In Russian)

A method is presented to calculate potential energy of deformation for fissile nucleus that enables one to take into account variation of the fragment charge density for arbitrary axial-symmetric forms of the fissile nucleus with a manifest scission neck. The potential energy is calculated by means of the Strutinsky method of shell correction. The calculations are fulfilled for ^{236}U, ^{238}U and ^{252}Cf assuming a constant charge density in any fragment at deformation from the saddle point up to the separation point. It follows from the results that the most probably fragment charge, being a sensitive function of the main fission deformation, determining the distance between centers of the future fragments, is in approximate agreement with the experimental data near the physical separation point. (auth)

31884 FRAGMENT MASS AND KINETIC ENERGY DISTRIBUTION FOR THE PHOTOFISSION OF ^{235}U AND ^{238}U WITH 25-MeV END-POINT BREMSSTRAHLUNG. De Clercq, A.; Jacobs, E.; De Frenne, D.; Thierens, H.; D'hondt, P.; Deruytter, A.J. (Laboratorium voor Kernfysica, Proeftuinstraat, 86, B-9000 Gent, Belgium). Phys. Rev. C 13: No. 4, 1536-1543 (Apr 1976).

Fragment energy correlation measurements have been made for the photofission of ^{235}U and ^{238}U with 25-MeV bremsstrahlung. The correlated energies of fission fragment pairs were measured with semiconductor detectors. Distributions of kinetic energy as a function of fragment mass were deduced. The results for the isotopes ^{235}U and ^{238}U are compared. They are discussed in terms of fragment shell effects and also in terms of the two-mode fission hypothesis. (auth)

31885 STRUCTURE OF THE FISSION TRANSITION NUCLEUS ^{235}U. Bouchard, R. S. M. Corvallis, OR; Oregon State Univ. (1976). 189p. University Microfilms Order No. 76-3826. Thesis (Ph. D.).

The structure of the fission transition nucleus ^{235}U was reinvestigated to determine the effects that a more realistic treatment of the fission barrier would have. The energy variation of the total fission cross section and the angular distributions in the neutron energy region from 200 to 843 keV were calculated using a Hauser-Feshbach formalism, including level-width fluctuation corrections. New features of this analysis include a double-humped fission barrier, K-mixing in the second minimum, coupling of states in the first and second wells, and damping effects; furthermore, two distinct assumptions were made regarding the nuclear shape of the inner barrier. In one case, the nuclear shape at the inner barrier was assumed to be reflection symmetric; in the other, reflection asymmetric. A reflection asymmetric nuclear shape at the outer barrier was assumed in both cases. Detailed comparisons of the calculated and experimental cross sections showed that the hypothesis that the nuclear shape is reflection symmetric at the inner barrier could be rejected at the 86 percent level of confidence using a chi^2 criterion. For the assumption of a reflection asymmetric nuclear shape, assignment of the inner and outer barrier heights and curvatures (E_1, E_3, h omega$_1$/2 pi, h omega$_3$/2 pi) were made for the three accessible states of the transition nucleus, (K,pi) equals $1/2+$, $3/2+$, and $1/2+$. The values of the inner barrier height deduced were systematically lower than current theoretical estimates by approximately one to two MeV, though the experimental and theoretical outer barrier heights agreed within one MeV. Widely differing values of the barrier curvatures were found for the different states of the transition nucleus. "Reasonable" agreement was found between theoretical predictions and the experimentally deduced character of the spectrum of low lying single particle states of the transition nucleus. (Diss. Abstr. Int., B)

31886 ANALYSIS OF THE NEUTRON INELASTIC SCATTERING CROSS SECTION FOR ^{235}U NUCLEI. Martynyuk, V. I.; Antsipov, G. V.; Korennoi, V. P.; Kon'shin, V. A. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 24-31(1975). (In Russian)

Using recent data on the ^{235}U level structure neutron inelastic scattering cross section σ_n' and level exitation functions for the target nucleus are calculated for the energy region from the threshold up to 3.5 MeV. Fission and radiative capture competition effects are taken into account. In the resolved level region a neutron and fission width fluctuation effect is included. The results are compared with the experimental data. (auth)

Nuclear Theory

Refer also to abstracts 30538, 31435, 31497, 31576, 31638, 31713, 32102, and 32103.

31887 (ANU-P-624) NUCLEAR BETA DECAY AND THE WEAK INTERACTION (NUCLEAR PHYSICS READING COURSE NOTES: 1973–74). Kean, D. C. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Nov. 1975. 36p. Dep. NTIS (US Sales Only) $4.00.

Short notes are presented on various aspects of nuclear beta decay and weak interactions including: super-allowed transitions parity violation, interaction strengths, coupling constants, and the current-current formalism of weak interaction.

31888 (CEA-CONF-3296) METHOD FOR A STATISTICAL MODEL EVALUATION OF CAPTURE, INELASTIC SCATTERING AND FISSION CROSS SECTIONS FOR HEAVY NUCLEI BETWEEN 1 keV AND 3 MeV. Thomet, P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 12p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

A method for a statistical model evaluation of radiative capture, fission and inelastic scattering cross sections for 1 keV to 3 MeV neutrons is described. In presence of fission competition, it consists of the determination of the fission channel characteristics by a least-squares fit to various experimental fission data such as angular distributions of fission fragments, total fission cross sections, etc. . . Some applications of this method are given afterwards. (FR)

31889 (CEA-CONF-3302) NEW NON-LOCAL SPHERICAL OPTICAL MODEL OF FOLDING TYPE USING A MATRIX METHOD. Salvy, J.; Bonnet, M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)). 1975. 19p. (In French). INIS.

From 3rd national soviet conference on neutron physics; Kiev, USSR (9 Jun 1975).

The possibility is examined for using a calculable R-matrix method to calculate the phase-shifts and scattering wave-functions from a neutron nonlocal spherical optical potential. This potential is generated from a folding procedure using a gaussian interaction, and new practical means for calculating the necessary matrix elements are proposed. Preliminary results showing up interesting convergence properties of this matrix method even for heavy nuclei are given. (FR)

31890 (CRN-PN-75-38) PROTON-NEUTRON CORRELATIONS AND SHELL-MODEL FOR COLLECTIVE MOTIONS. Ogawa, K. (Centre National de la Recherche Scientifique, 67- Strasbourg (France). Centre de Recherches Nucleaires). 1975. 22p. INIS.

A new truncation method for shell-model spaces is proposed, based on the proton-neutron correlations. The dominance of the quadrupole force in the p-n interactions is established by the investigation of empirical matrix elements in the pf-shell. A truncation scheme based on the quadrupole component of the p-n interactions is applied to the N = 30 nuclei and compared with exact shell-model calculations. Satisfactory agreement between the two results suggests the wide validity of the present truncation method when applied to collective phenomena in nuclei. A relation between the shell-model and the particle-vibration model is discussed. (FR)

31891 (IAEA-169(Vol.2), pp 1-32) STATUS OF DECAY DATA OF FISSION PRODUCTS. Rudstam, G. 1974.

From panel on fission product nuclear data; Bologna, Italy (26 Nov 1973).

In fission product nuclear data (FPND). Vol. II. (International Atomic Energy Agency, Vienna (Austria)).

The status of our present knowledge about fission product decay properties, i.e., half-life, mode of decay, beta- and gamma-ray energies and intensities, etc., is discussed. Compilations of such nuclear data are reviewed, and some recommendations are given. Contributions from Aten and from Large have been incorporated into the review, and reference is made to a number of other contributions to the panel. (auth)

31892 (IFA-FT-112-1975) THE DEPENDENCE OF THE ATTENUATION FACTOR, ON THE WAY OF POPULATING NUCLEAR STATES, IN THE NUCLEAR LIFETIMES DETERMINATIONS BY DOPPLER SHIFT ATTENUATION METHOD. Dorobantu, V. T.; Popa, M. S. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 7p. INIS.

The corrections necessary for the evaluation of the attenuation factor F (τ) in the DSAM experiments are taken into account for the case when no preselection of the studied nuclear state exists and considering the influence of the way of population of the last one. Since the experimental conditions can be rather complex, the generalization of these corrections is presented by having in view the manifold cascades by which the population of the studied state is carried out. (auth)

31893 (IPNO-T-75-06) SELF-CONSISTENT DESCRIPTION OF STATIC PROPERTIES OF NUCLEAR DEFORMATION FROM NUCLEON-NUCLEON EFFECTIVE INTERACTIONS. Quentin, P. (Paris-11 Univ., 91- Orsay (France). Inst. de Physique Nucleaire; Paris-11 Univ., 91- Orsay (France)). 1975. 380p. (In French). INIS.

A self-consistent description of deformed nuclei is presented in the Hartree-Fock approximation after correcting in an approximate but variational way for pairing correlations. Density dependent phenomenological effective interactions have been used, mainly according to the Skyrme's parametrization. Methods in use and various related approximations are reviewed in an extensive way. Calculated nuclei belong to the s-d shell, to the rare earth region, to the two transitional regions before and after the latter region, and to the actinide region. For all these nuclei, calculated deformation properties agree remarkably well with experimental data. Such results are extensively compared with those obtained in the more phenomenological approach due to Strutinsky. Finally the hypotheses formulated by Strutinsky are checked numerically in a systematic way, thus leading to the conclusion of the validity of the Strutinsky method. (FR)

31894 (IPNO-T-75-08) PHENOMENOLOGICAL AND THEORETICAL STUDY OF NUCLEAR FORCES. Richard, J.-M. (Paris-11 Univ., 91- Orsay (France). Div. de Physique Theorique; Paris-6 Univ., 75 (France)). 1975. 96p. (In French). INIS.

The two-pion exchange contributions to nucleon-nucleon forces are calculated from the knowledge of pion-nucleon phase-shifts and pion-pion interaction which are used as input into dispersion relations with the subtractions required by the Regge asymptotic behavior. The low energy peripheral nucleon-nucleon partial wave phase parameters are calculated from this two-pion exchange in addition with one-pion and omega meson exchange and compared with phenomenological energy independent and energy dependent phase-shift analyses. A nucleon-nucleon potential is also constructed which possesses a fundamental long and medium range part calculated from the previous dispersion relations. The short range part is determined phenomenologically by fitting the low partial waves as well as deuteron properties. Although the number of free parameters is small, the quality of the fit is very good. (FR)

31895 (IPNO-TH-CF-4) MEASUREMENTS AND CALCULATIONS OF NUCLEAR DEFORMATIONS. Quentin, P. (Paris-11 Univ., 91- Orsay (France). Inst. de Physique Nucleaire). 1975. 54p. (In French). INIS.

From congress of the French Physical Society; Dijon, France (30 Jun 1975).

Main sources of experimental data pertaining to equilibrium deformation properties are shortly reviewed. Different approximations and methods relevant to their systematical calculations are discussed and compared. Finally, a rapid survey of some open problems is undertaken. (FR)

31896 DESCRIPTION OF THE NUCLEAR SURFACE BY MOMENTS. Suessmann, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Z. Phys., A; 274: No. 2, 145-159 (1975).

3 figs.; 1 tab.; 10 refs.

The parameters proposed by W. D. Myers to describe the radial shape dependence of the nuclear surface are shown to be as useful as they are natural. For spherical nuclei, the central radius C, the charge radius R, the quadratic radius Q are redefined, and it is shown how they are interrelated by Myers' surface width b, flair γ_3, crookedness γ_4, and the higher shape parameter γ_5. All these quantities are calculated for some special charge distribution functions. (For symmetric distributions, possessing a symmetry center at C, the odd surface moments $b^3\gamma_3$ and $b^5\gamma_5$ vanish.) The connection of the surface moments $\Gamma_\mu = {}^\mu\Gamma_\mu$ with the volume moments F_K that have been extracted by K. W. Ford and J. G. Wills from muonic atoms is indicated. (DE)

31897 EXACTLY SOLUBLE MULTICHANNEL SCATTERING PROBLEMS WITH COULOMB INTERACTIONS. Cattapan, G.; Pisent, G.; Vanzani, V. (Padua Univ. (Italy). Istituto di Fisica). Z. Phys., A; 274: No. 2, 139-144(1975).

18 refs.

A general separable potential approach to elastic and inelastic scattering processes is developed which takes account of Coulomb interactions in an exact way. Effective nuclear interactions are used that are separable in the channel relative motion variables and take explicit account of the coupled-channel nature of the problem. After solving the coupled-channel integral equations by means of both matrix inversion techniques and a suitable channel-decoupling procedure, we arrive at exact manageable expressions of the Coulomb-corrected nuclear transition amplitudes. (DE)

31898 SIMPLE MODEL OF A RAPIDLY ROTATING NUCLEUS. Zelevinskii, V. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yad. Fiz.; 22: No. 6, 1085-1095(Dec 1975). (In Russian).

Nucleons are considered moving in an anisotropic harmonic oscillator potential and forming a system rotating with a large angular velocity. A self-consistent solution of the problem makes it possible to study the variation of nuclear properties caused by the rotation. The energies and characteristics of the nuclear shape are calculated for the lowest states with a given momentum. When the angular momentum increases the nucleus, beginning from the rotation round the axis orthogonal to the symmetry axis comes through nonaxial configurations to the states with the angular momentum aligned along the symmetry axis. Those states are genetically related to the spherical equilibrium form which

in the absence of rotation corresponds to higher energy than the deformed one. (auth)

31899 RADII OF NUCLEAR POTENTIAL AND DENSITY. Bal'butsev, E. B.; Mikhailov, I. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 6, 1096-1101(Dec 1975). (In Russian).

Some data outside the direct fitting procedure of the optical potential parameters are enumerated showing that the radius of the nuclear potential with diffused edge exceeds by about 0.6 fm the radius of the distribution of nuclear matter. The difference in the volumes taken by the matter and by the potential is attributed to the decrease of the single-particle wave functions at the surface of the nucleus. (auth)

31900 STOCHASTIC VARIATIONAL METHOD. Kukulin, V. I.; Krasnopol'skii, V. M. (Moscow State Univ.). Yad. Fiz.; 22: No. 6, 1110-1120(Dec 1975). (In Russian).

The stochastic version of the Reley–Ritz variational method is proposed to calculate ground and excited states of many-body systems. A nonorthogonal closed basis optimized by the trial and error method is used. A large number of parameters introduced systematically allows one to obtain a fast convergence of variational expansions even in the case when the expanded functions are not "like" the basis ones. Randomization of the basis leads to the following important feature: the convergence velocity does not depend on the number of particles and on the dimension of the space. The method is illustrated by the numerical results for the two-, three- and four-body systems. (auth)

31901 UNCONSTRAINED JASTROW VARIATIONAL CALCULATION ON NUCLEAR MATTER. Campani, E.; Fantoni, S.; Rosati, S. (Univ., Pisa, Italy). Lett. Nuovo Cim.; 15: No. 7, 217-220 (14 Feb 1976).

In the case of the sytem of Fermi particles interacting through purely central forces it is possible to check the validity of the existing low order approximations in detail, and to this end some results obtained for symmetrical nuclear matter are presented based on two previous approximations. The two central interparticle potentials having a state-independent hard core and a Serber exchange outside the core and the three-particle correlation function with a form allowing overshoot are considered. (JFP)

31902 PROGRAM FOR THE INITIAL PROCESSING OF THE APPARATUS SPECTRA OF (n,Z) REACTIONS. Aleksandrov, D. V.; Kovrizin, B. S. Prikl. Yad. Spektrosk.; No. 5, 48-50(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

A verbal description is given of the computer programming for the initial processing of nuclear reaction spectra. It consists in the measurement of individual events, their summation, corrections for the energy loss, and transfer of the spectra from the laboratory system to the center-of-mass system. The program is written in MOST-1. (JSR)

31903 DENSITY DEPENDENT EFFECTIVE INTERACTIONS OF NUCLEONS AND DIRECT NUCLEAR REACTIONS. Reif, R. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 22: No. 6, 1129-1135(Dec 1975). (In Russian).

Direct inelastic scattering of protons is treated in a microscopic approach with using the DWBA method and various density dependent interaction potentials. The excitation of collective octupole states and monopole transitions with an interaction proposed by Migdal is studied. The results obtained with finite range forces of Sprung and Banerjee are described. (auth)

31904 POSSIBILITY OF COMPRESSING RECORDED DATA IN NUCLEAR SPECTROSCOPY ON THE BASIS OF WALSH TRANSFORMS. Mukhin, V. I.; Fedorov, G. A. Prikl. Yad. Spektrosk.; No. 5, 30-37(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

The validity compressing data on the basis of Walsh transforms, which are realized by series expansion of discrete functions of the original data with respect to rectangular oscillation, was shown. Such a method is called zonal exclusion. The effectiveness of this method was verified on three types of spectral energy distribution functions. (JSR)

31905 ABSOLUTE NORMALIZATION OF THE CROSS SECTION OF NUCLEAR REACTIONS CALCULATED BY THE STATISTICAL THEORY. Aleksandrov, D. V.; Kovrizin, B. S. Prikl. Yad. Spektrosk.; No. 5, 38-41(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

An evaluation is made of validity of absolute normalizations made on the basis of improvements and generalizations of the statistical theory of nuclear reactions. (JSR)

31906 MEAN SQUARE RADIUS OF NUCLEAR ISOTOPES. Gul'karov, I. S. (Tashkent Polytechnical Inst.). Dokl. Akad. Nauk Uzb. SSR; No. 5, 20-22(1975). (In Russian).

The dependence of the values of $\langle r^2 \rangle^{1/2}$ on A was examined for the isotopes of all elements from Li to Pb which were measured by elastic scattering of electrons. The area of validity of laws relating the mean square radius to the atomic mass is determined. (JSR)

31907 GENERAL COEFFICIENTS FOR TALMI EXPANSIONS OF MATRIX ELEMENTS. Aguilera–Navarro, V. C.; Portilho, O. (Instituto de Fisica Teorica, Sao Paulo, Brazil). Lett. Nuovo Cim.; 15: No. 6, 169-173(7 Feb 1976).

The generalization of the Talmi expansion coefficients is carried out. It is pointed out that Talmi integrals play an important role in evaluating matrix elements in the shell model and in variational analyses using oscillator states. An example of an important instance that requires such a generalization is found in transition probability calculations which appear in fields such as the atomic, nuclear, and astrophysical. (JFP)

31908 SENIORITY IN PROJECTION OPERATOR FORMALISM. Ullah, N. (Tata Inst. of Fundamental Research, Bombay). Nuovo Cim., 31A: No. 2, 231-236(21 Jan 1976).

It is shown that the concept of seniority can be introduced in projection operator formalism through the use of the operator Q, which was defined by de-Shalit and Talmi. The usefulness of seniority concept in projection operator formalism is discussed. An example of four nucleons in $j = 3/2$ configuration is given for illustrative purposes. (auth)

31909 GEOMETRICAL-OPTICS PHENOMENA IN THE ELASTIC SCATTERING OF FICTITIOUS HEAVY NEUTRAL NUCLEI BY ABSORBING POTENTIALS. Anni, R.; Taffara, L. (Univ., Lecce, Italy). Nuovo Cim., A; 31A: No. 2, 321-355(21 Jan 1976).

A fictitious scattering phenomenon between neutral heavy particles is analyzed by using both the square-well and trapezoidal complex potentials. After a preliminary phenomenological discussion based on the behavior of the exact scattering matrix and the trajectories of Regge poles and zeros as continuous functions of the imaginary part of the potential, the contributions to the scattering amplitude from the external and multiple internal reflections and from the "surface waves" are separated by using the Debye expansion of the $S(\lambda)$-matrix. The most important first two terms of this expansion are then compared with the exact behavior of both the partial-wave scattering amplitude and cross section, and the results are discussed. In particular, for potentials with large imaginary parts, the first term of the Debye expansion, which is associated with the rays directly reflected by the surface, well approximates the exact scattering matrix for all angular momenta. In these cases, by applying to this first term the Watson transformation, one is able to separate the contributions from the reflected rays (saddle-point contribution in the background integral) from that of the surface waves (surface pole contribution) which are responsible for the diffraction phenomenon. Studies are in progress in order to extend this approach to the Saxon–Wood potential with Coulomb interaction. (auth)

31910 FINITE-RANGE COUPLED-CHANNELS BORN APPROXIMATION. Nagel, P.; Koshel, R.D. (Physics Department, Ohio University, Athens, Ohio 45701). Phys. Rev. C 13: No. 3, 907-914 (Mar 1976).

The formalism for calculating finite-range coupled-channels Born approximation differential cross sections is developed using the plane wave expansion method. A discussion of the computer code OUKID which was developed using this formalism is presented. A test of the reliability of this code is also presented and the effect of multistep processes on an α transfer reaction is shown. (auth)

31911 MODEL FOR SCATTERING FROM THE BOUND STATE OF A TWO-BODY SYSTEM. van Dijk, W.; Razavy, M. (Theoretical Physics Institute, Department of Physics, University of Alberta, Edmonton, Canada). Phys. Rev. C 13: No. 3, 944-952 (Mar 1976).

An exactly solvable model for scattering of a particle from the bound state of a two-body system is studied. In this model the motion of all particles is confined to one dimension. It is also assumed that the interaction between the projectile and the target is nonlocal and separable, but the potential between the target particles is local. Depending on the form of the latter potential two cases are considered: (1) the target is the ground state of a system whose eigenvalues are discrete and eigenfunctions localized, and (2) the target has only one bound state. In both cases the problem can be solved with overlapping

as well as nonoverlapping potentials. This model is used to test the accuracy of the fixed scatterer approximation. It turns out that in this approximation the two cases yield similar results. (auth)

31912 OFF-SHELL EQUIVALENCE IN THREE-BODY SCATTERING. Brayshaw, D.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. C 13: No. 3, 1024-1035 (Mar 1976).

Explicit relationships are derived connecting the author's boundary condition formalism to the Faddeev theory of three-body scattering. In particular, it is shown that suitable input to the boundary condition formalism can always be chosen so as to exactly reproduce the Faddeev amplitudes. This is also true in the presence of explicit three-body forces. It is further shown that such forces cannot be distinguished from off-shell properties of the two-particle interaction on the basis of three-particle scattering observables. A previous analysis of the n-d breakup reaction is discussed in some detail. (auth)

31913 l- AND j-DEPENDENT EFFECT IN (d, p) REACTIONS. Santos, F.D. (Laboratorio de Fisica, Universidade de Lisboa, Portugal). Phys. Rev. C 13: No. 3, 1145-1150 (Mar 1976).

A marked dependence of the tensor analyzing power T_{22} for (d, p) reactions on the quantum numbers l_n and j_n of the captured neutron has been observed. This small angle l_n and j_n dependence, which can be reproduced in distorted-wave Born-approximation calculations only by inclusion of deuteron D-state effects, is interpreted in terms of a simple reaction model based on the surface localization of the transfer process. (auth)

31914 ONE-DIMENSIONAL NUCLEAR DYNAMICS IN THE TIME-DEPENDENT HARTREE-FOCK APPROXIMATION. Bonche, P.; Koonin, S.; Negele, J.W. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. C 13: No. 3, 1226-1258 (Mar 1976).

The time-dependent Hartree-Fock theory is applied to the large amplitude dynamics of slabs of spin and isospin symmetric nuclear matter. The slabs are translationally invariant in two transverse dimensions, and with the simplified effective interaction used in this work, the problem is reduced to a set of coupled nonlinear equations for time-dependent functions of a single spatial variable. By specification of appropriate initial conditions, large amplitude oscillations of a single slab, the scattering of a slab from an external potential barrier, and collisions of two slabs have been investigated. The results evidence a wide variety of dynamic phenomena, including fusion, compound nucleus formation, dissipation, strongly damped collisions, shock wave propagation, and fragmentation. The microscopic aspects of the dynamics, the relation to fluid mechanics, and the practical and conceptual problems arising from the theory are discussed in detail. (auth)

31915 DYNAMICAL THEORY OF NUCLEAR FISSION. Fong, P. (Physics Department, Emory University, Atlanta, Georgia 30322). Phys. Rev. C 13: No. 3, 1259-1262 (Mar 1976).

The asymmetric fission problem is investigated from the dynamical theory point of view under a variety of conditions which cover most cases encountered in practice. Quantitative and qualitative results are obtained. In all the cases studied the dynamical theory cannot explain the experimental results of asymmetric mass distribution of fission products. (auth)

31916 ON THE MACROSCOPIC THEORY OF THE GIANT DIPOLE STATE. Bertsch, G.; Stricker, K. (Department of Physics, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. C 13: No. 3, 1312-1317 (Mar 1976).

A macroscopic theory of isovector states is derived from a reduction of random phase approximation. Using Skyrme interactions and assuming a dipole transition density of the Goldhaber-Teller shape, we find reasonable agreement with experimental excitation energies for the light nucleus ^{16}O. The theoretical excitation energies for heavy nuclei are too high by a couple of MeV. The transition density may be given a general parametric form which includes the hydrodynamic model as well as the Goldhaber-Teller model. A variational calculation of the form of the transition density gives the Goldhaber-Teller shape for light nuclei, and a shape between the hydrodynamic and Goldhaber-Teller models for ^{208}Pb. (auth)

31917 BACKGROUND PHASE SHIFT IN R-MATRIX THEORY. Gupta, S.K. (Van de Graaff Laboratory, Nuclear Physics Division, Bhabha Atomic Research Centre, Bombay 400085, India). Phys. Rev. C 13: No. 3, 1326-1329 (Mar 1976).

It has been shown recently by Cugnon in his generalized version of the R-matrix theory that the hard sphere phase shift used in the standard R-matrix theory is arbitrary and can be replaced, in general, by any other phase shift. In the present paper similar results have been derived in a straightforward manner, within the framework of the standard R-matrix theory, from the usual division of R matrix into a background matrix R_0 plus a matrix R' containing pole terms and further constraining R_0 to be a diagonal matrix. Thus Cugnon's theory and the standard R-matrix theory lead to algebraically equivalent results. An expression for the renormalization factor for the reduced width has also been given in terms of the new phase shift and the hard sphere phase shift. (auth)

31918 LOW-ENERGY-PION ELASTIC SCATTERING FROM LIGHT NUCLEI. Cooper, M.D. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544); Eisenstein, R.A. Phys. Rev. C 13: No. 3, 1334-1337 (Mar 1976).

Simple π-nucleus optical potentials constructed from π-N phase shifts yield poor fits to elastic scattering from He and C below 75 MeV. Forcing a fit gives potentials which are pion producing or in violation of unitarity. The forward position ($\sim 65°$) and breadth of the minimum are shown to be partially responsible. These features are also shown to require a much stronger s-wave interaction with nuclei than that derived from π-N scattering. (auth)

31919 PERTURBATION THEORY OF EFFECTIVE HAMILTONIANS. Brandow, B. H. (Los Alamos Scientific Lab., N. Mex. (USA). Theoretical Div.). pp 1-24 of Effective Interactions and Operators in Nuclei. Proceedings. Barrett, B. R. (Ed.) (Arizona Univ., Tucson (USA). Dept. of Physics). Berlin, F.R. Germany; Springer (1975).

From international topical conference on nuclear physics; Tucson, Ariz. (2 Jun 1975). 46 refs.

The paper deals with the non-degenerate perturbation theory in the Brillouin–Wigner and the Rayleigh–Schroedinger methods. In accordance with the Kato–Bloch formalism of degenerate theory both methods are used in many-body problems of nuclear physics. (DE)

31920 INERTIA, FRICTION, AND ANGULAR MOMENTUM OF AN OSCILLATING VISCOUS CHARGED LIQUID DROP UNDER SURFACE TENSION. Hasse, R. W. (Univ., Munich). Ann. Phys. (N. Y.); 93: No. 1-2, 68-87(5 Sep 1975).

The eigenfrequencies of an oscillating viscous charged liquid drop under surface tension are evaluated by assuming potential flow and by solving the linearized Navier–Stokes equation. The kinetic and dissipation energies of this system are obtained via the inertias and friction coefficients and the angular momentum of the drop is calculated. A discussion of the nature of the viscous flow reveals that for small viscosity the curls tend to concentrate close to the surface (boundary layer effect); once having excited the drop, the fluid can come to rest only asymptotically (caused by the curls); and that the potential flow approximation has only a limited validity. (auth)

31921 EXCHANGE SYMMETRY OF THE EFFECTIVE INTERACTION IN THE LANDAU-MIGDAL THEORY OF FINITE FERMI SYSTEMS. Bauer, R.; Ebert, K.; Ring, P.; Theis, W.; Werner, E.; Wild, W. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Department). Z. Phys., A; 274: No. 1, 41-49(Aug 1975).

The particle exchange symmetry of the phenomenological effective particle-hole interaction used in the theory of Finite Fermi Systems is investigated. It is found that experimental data and consistency relations support an interaction which is antisymmetric at the surface and in the exterior region of the nucleus and nonsymmetric in the interior. Besides, it is shown that the number of adjustable parameters of the effective interaction can be reduced substantially by the use of generalized Ward identities without any loss of agreement with experimental data. (DE)

31922 FOLDED DIAGRAM THEORY, TIME-DEPENDENT APPROACH OF JOHNSON AND BARANGER. Johnson, M. B. (Los Alamos Scientific Lab., N. Mex. (USA). Meson Physics Facility). pp 25-41 of Effective Interactions and Operators in Nuclei. Proceedings. Barrett, B. R. (ed.) (Arizona Univ., Tucson (USA). Dept. of Physics). Berlin, F. R. Germany; Springer (1975).

From international topical conference on nuclear physics; Tucson, Ariz. (2 Jun 1975). 17 figs.; 8 refs.

The paper deals with the application of folded and Goldstone diagrams on a time-dependent perturbation theory of many-body problems. (DE)

31923 COMPUTATION OF THE REACTION MATRIX, G. Becker, R. L. (Oak Ridge National Lab., Tenn. (USA)). pp 96-117 of Effective Interactions and Operators in Nuclei. Proceedings. Barrett, B. R. (ed.) (Arizona Univ., Tucson (USA). Dept. of Physics). Berlin, F. R. Germany; Springer (1975).

From international topical conference on nuclear physics; Tucson, Ariz. (2 Jun 1975). 5 figs.; 53 refs.

A method is given for the rigorous numerical solution of the Bethe–Goldstone equation and thus for the calculation of the Brueckner G matrix. (DE)

31924 PERTURBATION CALCULATION IN A DOUBLE-PARTITIONED HILBERT SPACE. Barrett, B. R. (Arizona Univ., Tucson (USA). Dept. of Physics). pp 119-133 of Effective Interactions and Operators in Nuclei. Proceedings. Barrett, B. R. (ed.) (Arizona Univ., Tucson (USA). Dept. of Physics). Berlin, F. R. Germany; Springer (1975).

From international topical conference on nuclear physics; Tucson, Ariz. (2 Jun 1975). 8 figs.; 2 tabs.; 9 refs.

In the framework of the microscopic theory for the determination of the effective interaction, a method is given for the computation of this effective interaction in the perturbation theory. The method used is the double partitioning method. The results are discussed. (DE)

31925 IS THERE A UNIVERSAL RELATIONSHIP CONNECTING ALL TWO-BODY EFFECTIVE INTERACTIONS. Schiffer, J. P. (Argonne National Lab., Ill. (USA); Chicago Univ., Ill. (USA)). pp 168-190 of Effective Interactions and Operators in Nuclei. Proceedings. Barrett, B. R. (ed.) (Arizona Univ., Tucson (USA). Dept. of Physics). Berlin, F. R. Germany; Springer (1975).

From international topical conference on nuclear physics; Tucson, Ariz. (2 Jun 1975). 12 figs.; 4 tabs.; 5 refs.

Information on the effective interaction of nucleons in atomic nuclei are derived using transfer reaction which enables the testing of the purity functions to be made. (DE)

31926 PARITY DISTRIBUTION OF EXCITED NUCLEI. Blokhin, A. I.; Ignatyuk, A. V. (Inst. of Physical Energy, Moscow). Yad. Fiz.; 23: No. 1, 61-63(Jan 1976). (In Russian)

Simple thermodynamical relations are obtained for the contributions from the positive and negative parity states to the level density of an excited nucleus. (auth)

31927 SUBSEQUENCE OF VARIATIONAL PRINCIPLES IN MULTICHANNEL THEORY OF NUCLEAR REACTIONS. Zubarev, A. L. (Tashkent State Univ.). Yad. Fiz.; 23: No. 1, 77-81(Jan 1976). (In Russian)

The equivalence of Schwinger variational principle to the separation method is used to show that the variational procedure of building an optimal combination of N trial functions, based on Schwinger functional for an interaction being a finite range N operator, leads to an exact scattering amplitude. Convergence problems are studied. (auth)

31928 FRENEL CORRECTIONS TO THE EIKONAL APPROXIMATION BY SEPARATION METHOD. Zubarev, A. L.; Musakhanov, M. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yad. Fiz.; 23: No. 1, 82-86(Jan 1976). (In Russian)

A method of separation of a potential by approximate solutions of the Schroedinger equation is proposed. The method leads to the Schwinger variational principle for the scattering amplitude. These results are used to calculate the Frenel corrections to the Glauber approximation. (auth)

31929 STATISTICAL PROPERTIES OF MANY-PARTICLE SPECTRA. Mon, K. K.; French, J. B. (Princeton Univ., NJ). Ann. Phys. (N.Y.); 95: No. 1, 90-111(Nov 1975).

Many-particle eigenvalue densities, generated by k-body interactions in asymptotically large spectroscopic spaces, are studied in terms of the density moments of a Gaussian orthogonal ensemble of such interactions. It is shown that the densities approach Gaussian as particle number increases; the rate of approach is determined, as is the rate of departure from the semicircular form which obtains in the few-particle limit, as well as the low moment representation for intermediate cases. By considering the variances of the moments it is shown that a convergence in probability of the individual densities to the ensemble-averaged density, first demonstrated by Grenander for the few-particle limit, is valid in general. In part as a preliminary to a study of the density and spectrum fluctuations, explicit forms are derived for the covariances of low order moments for arbitrary particle number and of moments of general order in the few-particle and many-particle limits. In the limiting cases the ensemble eigenvalue densities are exhibited in terms of a set of statistically uncorrelated Chebyshev or Hermite-polynomial excitations of the ensemble-averaged densities. Some explicit results for GOE fluctuations are given. (auth)

31930 MOLECULAR ORBITAL APPROACH TO THE CHEMICAL INTERPRETATION OF MOESSBAUER EFFECT. Kothekar, V. (All India Inst. of Medical Sciences, New Delhi. Dept. of Biophysics). Proc. Indian Natl. Sci. Acad., Part A; 40: No. 2, 112-123(Mar 1974).

A complete formalism has been given for the calculation of Mössbauer Effect (ME) parameters on the basis of Extended Huec kel Treatment (EHT) of Hoffman and self-consistent field (SCF) method, along with the development of SCF method with CNDO/II approximation for transition element compounds. Calculations of electronic charge distribution around iron atom have been done for oxyhemoglobin, deoxyhemoglobin, nitricoxide hemoglobin, FeS_2, and FeO using both EHT and CNDO/II method. ME parameters are calculated from this population analysis and compared with the experimental results. (auth)

31931 PROMISING RESULTS IN NUCLEAR MATTER WITH RECENT NONLOCAL SEPARABLE INTERACTIONS. Meunier, J. P.; Pigeon, J.; Meyer, J.; Elbaz, E. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire). Can. J. Phys.; 53: No. 12, 1193-1205(15 Jun 1975).

New parametrizations of nonlocal separable interactions have been proposed recently by different authors. All of these potentials reproduce the two nucleon data fairly well without increasing the rank of the interaction. In this paper the nuclear matter properties have been calculated in the Brueckner pair approximation. Two of these parametrizations give results comparable with the Reid soft core local interaction. Thus, such nonlocal interactions may be promising candidates for further nuclear structure calculations. (auth)

31932 CENTRAL INSTITUTE OF NUCLEAR RESEARCH OF THE ACADEMY OF SCIENCES OF THE GDR. Flach, G.; Collatz, S.; Hohmuth, K.; Muenze, R. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Kernenergie; 18: No. 7, 197-200(1975). (In German)

A brief review is given of the history of evolution, the most important recent and future research problems of, as well as some essential results from the Central Institute of Isotope and Radiation Research of the Academy of Sciences of the GDR in Leipzig. (GC)

31933 FRAGMENTATION OF RELATIVISTIC HEAVY IONS. Luk'yanov, V.K.; Panebrattsev, Y.A.; Titov, A.I. (Joint Institute for Nuclear Research). JETP Lett. 22: No. 8, 205-206 (20 Oct 1975).

The first experiments on the fragment yields in reactions with relativistic heavy ions are explained on the basis of a two-stage mechanism of the process. During the first stage the ion is excited by peripheral collision with the target nucleus, and during the second stage it decays statistically in flight and emits the fragment. (auth)

31934 MICROSCOPIC THEORY OF NUCLEAR ROTATIONAL STATES. Nadjakov, E. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). pp 2 v.; v.1 p.493-514 of Heavy-Ion, High-Spin States and Nuclear Structure. Lectures Presented at the International Extended Seminar on Nuclear Physics at Trieste from 17 September to 21 December 1973 Organized by the International Centre for Theoretical Physics, Trieste. Vienna; IAEA (1975).

From international extended seminar on nuclear physics; Trieste, Italy (17 Sep 1973).

A microscopic method for a consistently quantal three-dimensional representation of nuclear rotation and its coupling to other modes is described. It is analogous to the random phase approximation (RPA) for vibration and in general permits an equally simple description of energies and transition rates. The method is based on the introduction of elementary transition operators, coupling the states in or between nuclear rotational bands; they can be regarded as a generalization of the phonons describing vibrations. The algebra of the transition operators is studied, and a general expansion for an arbitrary multipole operator (F_{LM}) of an external field in terms of these transition operators is proposed; it is analogous to the boson expansion in theory of vibrations. Transition rates are described by the reduced matrix elements of F_{LM}, using its expansion in terms of the transition operators, and their algebraic properties. A most general expression for the angular-momentum-dependent corrections to the unified model Alaga branching rules is obtained in a model-independent way, the dynamics remaining in the expansion coefficients only. We apply a generalized equations-of-motion method in order to find the quasi-particle structure of the transition operators (the amplitudes in their expansion in terms of quasi-particle excitations, similar to the RPA phonon amplitudes). The energies and F_{LM}-coefficients, i.e., the transition rates, can then be determined in terms of these amplitudes. The results are free from the quasiclassical and two-dimensional ambiguities of the cranking model, but reproduce it in the lowest-order approximation. The procedure is illustrated by a calculation of E2 moments and transition rates in the ground-state rotational bands of several even-even rare earth nuclei. Corrections to the unified model, meaning changes in intrinsic moments, respectively deformations, with rotation are obtained and compared to experiment. (auth)

31935 OFF-SHELL MANDELSTAM REPRESENTATION FOR THE SECOND BORN TERM OF A YUKAWA POTENTIAL. Gillespie, G.H. (Department of Physics and Institute for Pure and Applied Physical Sciences, University of California at San Diego, La Jolla, California 92037). Phys. Rev. D 13: No. 3, 725-729 (1 Feb 1976).

The well-known result for the on-shell Mandelstam representation of the nonrelativistic second Born term of a Yukawa potential is extended to the general off-shell case for real-valued momentum and positive energies. The resulting representation is shown to differ from the on-shell case in two aspects. The first is a simple extension of the spectral function and corresponding Mandelstam boundary to the off-shell case which includes two additional parameters. These parameters simply reflect the extension to the case of arbitrary magnitudes for the initial- and final-state momentum off-shell. The second aspect is a change of sign of the principal-value (real) part of the representation off-shell which is not reflected by the imaginary part alone. This sign remains the same as that of the on-shell amplitude for all values of off-shell momentum only at sufficiently low energies. The critical scattering energy, above which the off-shell results differ in sign in a low-momentum region from those of the on-shell case, is determined by the mass of the exchanged particle. For the case of pion-exchange between nucleons, this energy corresponds to about 40 MeV in the laboratory. Potential implications for the calculation of two-pion–exchange contributions to nuclear potentials are discussed. (auth)

31936 MATRIX PADÉ APPROXIMANTS AND THE BETHE-SALPETER EQUATION OF THE *N-N* INTERACTION. Gersten, A.; Owen, D.A. (Department of Physics, Ben-Gurion University of the Negev, Beer-Sheva, Israel); Gammel, L.J.; Méry, P.; Turchetti, G. Phys. Rev. D 13: No. 4, 1140-1143 (15 Feb 1976).

We discuss the problem of which diagrams should be taken for the matrix Padé analysis and for the Bethe-Salpeter equation. We relate the "potential" of the Bethe-Salpeter equation with bare intermediate nucleons to the "potential" of the Bethe-Salpeter equation with dressed intermediate nucleons. We discuss the origin of the differences in recent calculations of the nucleon-nucleon phase shifts based on matrix Padé approximants. (auth)

31937 PION-EXCHANGE CONTRIBUTIONS TO TWO-PHOTON AMPLITUDES AND THE NUCLEAR MAGNETIC SUSCEPTIBILITY. Friar, J.L. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). Phys. Rev. Lett. 36: No. 10, 510-514 (8 Mar 1976).

The pion-exchange contributions to the two-photon amplitude are derived and gauge invariance of the complete amplitude is shown. A low-energy theorem for a general two-photon process is derived and the pionic contributions to the magnetic susceptibility is calculated. The contribution of this quantity to *n-p* two-photon radiative capture is shown to be small. (auth)

31938 THREE-PARTICLE ASPECTS IN AN *N/D* APPROACH TO NUCLEAR REACTIONS. Greben, J.M. (Kernfysisch Versneller Instituut, State University, Groningen, The Netherlands); Kok, L.P. Phys. Rev. C 13: No. 4, 1352-1366 (Apr 1976).

Several approximations in a generalized *N/D* approach to nuclear reactions are tested for the three-nucleon system. A detailed analysis of the analytic structure of the amplitudes for transitions between stable two-particle channels is presented. Three-particle unitarity is treated with a method which preserves the simple structure of the one variable *N/D* equations. Calculations for the three-nucleon system are compared with the exact solutions of the Amado equations. The importance of exchange contributions to three-particle unitarity is stressed. (auth)

31939 THREE-CLUSTER STATES IN REACTION THEORY. Rosenberg, L. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. C 13: No. 4, 1406-1419 (Apr 1976).

In recent work it was shown how a rigorous subsidiary minimum principle of the Rayleigh-Ritz type could be used as an aid in the construction of the closed-channel part of the scattering wave function, thereby making available a potentially powerful new tool in the variational approach to multiparticle scattering problems. The earlier discussion, which was restricted to scattering below the threshold for target breakup, is generalized here to the case where both two-body and three-body channels are open. The scattering problem is formally reduced to an equivalent three-body problem. Effective two-body and three-body potentials are defined explicitly (without the use of projection operators) and integral equations of the Faddeev type are derived. This analysis, which suggests a variety of cluster approximations, is used here as the basis for a decomposition of the wave function into an open-channel part, which contains the two-body and three-body outgoing scattered waves, and a decaying closed-channel part. The closed-channel part is shown to satisfy a minimum principle whose rigor can be maintained even when the target bound-state wave functions are imprecisely known. A calculational procedure which combines this minimum principle with the Kohn variational construction of the scattering amplitude is described. (auth)

31940 FLUCTUATION CROSS SECTION IN THE CASE OF AN ISOLATED DOORWAY RESONANCE. Hussein, M.S. (Pelletron Laboratory, Instituto de Física, Universidade de São Paulo, Caixa Postal no. 20.516, São Paulo, Brasil). Phys. Rev. C 13: No. 4, 1420-1423 (Apr 1976).

In this note we discuss some aspects of the fluctuation part of the cross section at a doorway resonance. We show that in the strong absorption limit an inequality is derived for $\Gamma^{\downarrow}$, namely, $\Gamma^{\downarrow} \geq (2/N^{1/2}-1)\,\Gamma^{\uparrow}$ where N is the number of open channels. In the strong absorption limit no doorway resonance appears in the average cross section. (auth)

31941 ANTISYMMETRY IN THE THREE-NUCLEON-INTERACTION MATRIX ELEMENTS. Waroquier, M.; Heyde, K.; Vincx, H. (Institute for Nuclear Physics, Rijksuniversiteit Gent, Proeftuinstraat, 86, B-9000 Gent, Belgium). Phys. Rev. C 13: No. 4, 1664-1673 (Apr 1976).

The inclusion of three-body forces to the effective nucleon-nucleon interaction has been frequently applied in nuclear self-consistent Hartree-Fock calculations. Thus, a dependence of the effective force on the nucleon density is exhibited, stimulating great interest in this manner. Antisymmetrized three-body matrix elements are evaluated, and applied with a zero-range three-body force within a finite basis of spherical single-particle states. The imposed antisymmetry ignores the existence of matrix elements of three identical nucleons. It provides for a better understanding of the structure of the three-body contribution to the Hartree-Fock ground state energy and for the exact relation between the three-body force and a density dependent two-body force. The discussion is given as well for spherical as for deformed nuclei. Problems concerning possible overbinding and violation of the spin stability by the zero-range three-body interaction are examined and represented in the angular momentum picture. (auth)

31942 GROUND STATE PROPERTIES OF MEDIUM-HEAVY NUCLEI WITH A REALISTIC INTERACTION. Goodman, A.L. (Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213); Vary, J.P.; Sorensen, R.A. Phys. Rev. C 13: No. 4, 1674-1697 (Apr 1976).

The Brueckner *G* matrix appropriate for medium-heavy nuclei is obtained from the Reid soft-core nucleon-nucleon potential. The *G* matrix is strongly affected by the Pauli operator *Q*, which is treated exactly (no angle averaging). Within the range of valence space energies *G* has a weak dependence on the starting energy ω. Ground state properties of deformed rare earth nuclei (Z=64–76, N=90–102) and spherical semimagic nuclei (Sn, Pb, N=82, N=126) have been calculated in the Hartree-Fock-Bogoliubov approximation with an inert core of 110 nucleons. Deformations and pair gaps are both determined by the *G* matrix. The systematic experimental dependence of $\epsilon_{\text{spherical}}$, β_2, β_4, Δ_p, Δ_n, and E_{pc} (prolate-oblate energy difference) on N and Z is reproduced. However, the magnitudes of β_2, Δ_n, and E_{pc} are too small. This may be largely due to the lack of isospin dependence of the oscillator basis states. β_2 and E_{pc} could receive additional significant contributions from core polarization of the 110 particle core which is neglected here. The Hartree-Fock-Bogoliubov ground states obtained with this realistic interaction provide a reasonable foundation for high spin calculations. (auth)

31943 CRITIQUE OF THE LOCALLY LINEARIZED APPROXIMATION TO THE NUCLEAR SINGLE PARTICLE DENSITY MATRIX. Kessler, D.; Negele, J.W. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. C 13: No. 4, 1698-1701 (Apr 1976).

Approximations to the density matrix of a Fermi gas in an external potential by Baltin and by Balazs and Zipfel are shown to be closely related. Predictions for the kinetic energy density using these approximations are compared to exact solutions for two harmonic oscillator problems and for Woods-Saxon wave functions in the lead nucleus. In all three cases, the approximations yield substantial systematic discrepancies, indicating that they are inadequate for quantitative description of the nuclear density matrix. (auth)

31944 TREATMENT OF CENTRIFUGAL ELASTIC STRESSES IN NUCLEAR ROTATION. Azziz, N. (University of Puerto Rico and Puerto Rico Nuclear Center, Mayaguez, Puerto Rico 00708); Palathingal, J.C.; Méndez-Plácido, R. Phys. Rev. C 13: No. 4, 1702-1708 (Apr 1976).

A treatment of elastic stresses in nuclear rotation with the nucleus considered as an incompressible elastic body with a stationary spherical core surrounded by a circulating mass is presented. Centrifugal stresses acting in directions perpendicular to the axis of rotation introduce variations in the moment of inertia. The variable moment of inertia model, so successful in predicting the rotational spectrum of even-even nuclei, is explained. (auth)

31945 SELF-CONSISTENT GENERATOR COORDINATE METHOD. Laskowski, B.; Brändas, E. (Quantum Theory Project, Chemistry and Physics Departments, University of Florida, Gainesville, Florida 32611). Phys. Rev. C 13: No. 4, 1741-1744 (Apr 1976).

An optimum continuous representation technique derived in analogy with the self-consistent harmonic approximation in quantum lattice dynamics is discussed and applied to Lipkin's model. The method is based on the variational principle and corresponds to an infinite summation of an expansion of the appropriate Hamiltonian kernel. The overlap kernel is treated exactly. The actual results indicate the removal of the drawbacks of low order perturbation theory previously employed in this connection. (auth)

31946 SENSITIVITY OF π^+ AND π^- INELASTIC SCATTERING TO DIFFERENCES IN THE NEUTRON AND PROTON AMPLITUDES. Morris, C.L. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. C 13: No. 4, 1755-1758 (Apr 1976).

We derive an expression relating the ratio of the cross sections for π^+ and π^- inelastic scattering to the ratio of the deformation parameters for the neutron and proton distributions. Calculations are described which determine the parameters in this relation, and the sensitivity of these parameters to the potential model used. (auth)

31947 PROLATE-OBLATE ENERGY DIFFERENCE AND SHAPE VARIATION IN THE *f-p* SHELL. Castel, B.; Goeke, K. (Physics Department, Queen's University, Kingston, Canada). Phys. Rev. C 13: No. 4, 1765-1767 (Apr 1976).

The importance of prolate-oblate potential energy difference in determining the structure of light- and medium-weight nuclei is examined in a Hartree-Fock-Bogoliubov calculation using the generator coordinate method. The results corroborate the earlier observations of Kumar regarding the correlation between the sign of the prolate-oblate energy difference and the crossing of the 2_2^+ and 4^+ states in even-even nuclei. Arguments based on time-dependent Hartree-Fock results are presented to support earlier observations regarding the predominance of prolate type quadrupole moments. (auth)

31948 EFFECTIVE CHANNEL APPROACH TO NUCLEAR SCATTERING AT HIGH ENERGIES. Rule, D. W. Storrs, CT; Univ. of Connecticut (1975). 209p. University Microfilms Order No. 76-1707.

Thesis (Ph. D.).

The description of high energy nuclear reactions is considered within the framework of the effective channel approach. A variational procedure is used to obtain an expression for the Green's function in the effective channel, which includes the average fluctuation potential, average energy, and an additional term arising from the non-commutability of the kinetic energy operator and the effective target wave function. The resulting expression for the effective channel, containing one variational parameter, is used to obtain the coupling potential. Thus a completely and consistently specified set of coupled equations is obtained which can then be systematically improved and extended. The resulting formulation is applied to the elastic scattering of 1 GeV protons by ^{4}He nuclei in order to investigate the feasibility of obtaining information on dynamical correlations among the target nucleons and information on off-shell effects. A simple gaussian form is used for the spin-isospin averaged proton-nucleon interaction. The variational parameter in the effective channel wave function is fixed a posteriori via the total p-^{4}He cross-section. The effect of the coupling to the effective channel is demonstrated, as well as the effect of each term in the coupled equation for this channel. The calculated elastic cross sections were compared to both the recent data from Saclay and the earlier Brookhaven data for the 1 GeV p-^{4}He elastic scattering cross section. The possibility of using proton-nucleus elastic scattering experiments to produce a refined estimate of the ratio of the real part to the imaginary part of the proton-nucleon elastic scattering amplitude is explored. The main purpose of our study is to investigate the effects on the cross section of varying, within its estimated range of uncertainty, each parameter which enters into the coupled equations. The magnitude of these effects was found to be large enough to conclude that any effects due to dynamical correlations would be obscured by the uncertainties in the input parameters. (Diss. Abstr. Int., B)

31949 LAW OF CORRESPONDING STATES IN ELASTIC SCATTERING THEORY. Milin, N. Jamaica, NY; St. John's Univ. (1975). 64p. University Microfilms Order No. 76-2997.

Thesis (Ph. D.).

The idea of corresponding states has been successfully utilized in Statistical Mechanics in numerous ways, e.g., to summarize and correlate empirical data, to study the quantum effects in various properties of matter, to predict the properties of a substance from the experimental data of other substances where no satisfactory theoretical treatment existed–to name a few. Similar possibilities for utilizing the idea of corresponding states exist in the elastic scattering where one is faced with the practically impossible theoretical problem of evaluating the T-matrix when calculating the scattering cross-section in analogy with a similarly difficult problem of calculating the partition function in Statistical Mechanics. Analogous to the Law of Corresponding States (LCS) of Statistical Mechanics, a law of corresponding states in elastic scattering theory is derived by means of operator methods, enabling us to relate cross sections of different scattering systems. Applications of LCS in elastic scattering are given where experimental data is used to relate hitherto theoretically unrelated scattering cross-sections. For the case of H–Ar where the potential has been determined indirectly, a linear equation relating sigma/sup 1/2/ and log E is predicted by means of LCS. (Diss. Abstr. Int., B)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 29325, 29609, 29645, 30192, 30518, 31044, 31122, 31652, 31932, 31997, and 32000.

31950 (AD/A-009181) LEAD BELT RADIATION SHIELD. Final Report, Sep-Dec 1974. Burgio, J. J. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Mar 1975. 21p. (SAT-TN-75-1). NTIS $3.25.

Results are given of the effectiveness of a lead shielding belt in reducing the γ dose to the center of a cylindrical tissue-equivalent phantom exposed to isotropic γ radiation. Three different shield designs were used. The first was a lead belt 20-cm high (wide), of a thickness varying from 0.0 (no belt) to 5.08 cm. The second design belt was 30-cm high (wide), of thickness varying from 0.0 cm (no belt) to 5.08 cm. For the third case, the 20-cm high (wide) lead belt of a thickness varying from 0.0 cm (no belt) to 5.08 cm was used but with a lead seat and back. The results demonstrate the feasibility of using a lead belt to reduce the γ tissue dose to a tissue-equivalent phantom from an isotropic γ source. (GRA)

31951 (EUR-5287) RADIOLOGICAL PROTECTION. Technical Recommendations for Monitoring the Exposure of Individuals to External Radiation. (Commission of the European Communities, Luxembourg). 1975. 35p. INIS.

Advice is given on the assessment of personal doses received by each worker. The objectives of individual monitoring programs, and the requirements which personal dosemeters should satisfy are given. The paper is mainly concerned with assessment of doses due to photon and electron radiations. (auth)

31952 (IAEA-R-1139F) STUDY ON COMPUTER INPUT DATA AND DESIGN OF AN ISODOSE PLOTTER. Part of a Coordinated Programme on Computer Applications in Clinical Dosimetry. Final Report for the Period 1 January 1972–31 March 1974. Binder, W. (International Atomic Energy Agency, Vienna (Austria)). Dec 1974. vp. INIS.

To study the assessment of input data for different computer programs available in the field of computerized treatment planning in radiotherapy, an automatic isodose plotter was successfully designed and constructed. The isodose plotter is a remote controlled device for making measurements of any radiation field in a water phantom in one to three dimensions. It consists of a lucite water phantom (40 × 40 × 40 cm) with a 2 mm polystrene entrance window (20 × 20 cm), a mechanical system for holding and driving the chambers in the X and Y directions and a printing board. A special electronic system was developed for the perception of the measuring signals and printing of isodoses. The isodose plotter with an ionization chamber is capable of plotting isodose points in the X and Y directions at distances adjustable from 1.5 to 10 mm. It can be used for 14 different isodose levels and is very easy to handle. (auth)

31953 NUCLEAR SCATTERING APPLIED TO RADIOGRAPHY. Saudinos, J. (CEN de Saclay, Gif-sur-Yvette, France); Charpak, G.; Sauli, F.; Townsend, D.; Vinciarelli, J. Phys. Med. Biol.; 20: No. 6, 890-905(Nov 1975).

The possibility of using the nuclear scattering of 500 to 1000 MeV protons was investigated in order to obtain direct, three-dimensional reconstruction of an object with only one exposure. The resolution should be about 1 mm^3. Preliminary measurements with an incomplete set-up gave a resolution of 10 mm^3. Additional independent information on the relative concentration of hydrogen compared to other elements should also be obtainable by nuclear scattering radiography. The radiation doses involved were comparable to those of other techniques. The first experimental results are given. (auth)

31954 SECONDARY RADIATION FROM A SPHERICAL TISSUE-EQUIVALENT PHANTOM IRRADIATED WITH ^{60}Co GAMMA RADIATION AND 6 MV X-RAYS. Nilsson, B. (Inst. of Radiophysics, Stockholm). Phys. Med. Biol.; 20: No. 6, 963-973(Nov 1975).

The angular dependence and the dependence on the phantom mass of the secondary exposure rate from spherical tissue-equivalent phantoms irradiated with ^{60}Co gamma radiation and 6 MV x-rays have been investigated both by measurement and by calculation using the Monte Carlo method and approximate methods. A nonlinear dependence on the phantom mass was found. Calculation of the differential photon fluence was also made. These measurements and calculations can be used when calculating the required barrier thickness for walls which are not hit by primary radiation. (auth)

31955 RAPID DEPTH DOSE DETERMINATION BY A COMPUTER-CONTROLLED DOSIMETRY SYSTEM. Bottrill, D. O.; Nieman, M. J.; Redpath, A. T. (Western General Hospital, Edinburgh). Phys. Med. Biol.; 20: No. 6, 980-989(Nov 1975).

A comprehensive depth dose measuring system controlled by a small computer has been designed to enable full depth dose information for a linear accelerator to be obtained within one day. An ionization microchamber was moved rapidly under computer control in a horizontal plane to preselected points within a water phantom by two stepping motors to a spatial resolution of 0.025 mm. The ionization current pulses were converted to DC voltages by an interface providing complete charge integration and yet having a rapid response to drastic changes in dose level. These were fed to the computer for analysis and subsequent conversion to depth dose data. The chamber path followed a preselected fan-shaped grid after automatic determination of the X-ray beam central axis. The combination of rapid chamber motion with halts for charge integration and computer sampling has resulted in fast data acquisition independent of measurement response times. This information, which was stored on disc, could be directly read by a treatment planning program. The overall accuracy of measurement lay within 0.5% of the true depth dose at any point. Central axis and transverse profiles could be assessed at the time of measurement through visualization on the computer storage oscilloscope. (auth)

31956 DOSE DISTRIBUTIONS IN BIOLOGICAL TISSUE FROM SUPERHIGH-ENERGY NUCLEON BEAMS. Dmitrievskii, I. M.; Potemkin, E. L.; Frolov, V. V. Sov. At. Energy (Engl. Transl.); 36: No. 4, 376-377(Apr 1974).

Methods and results of calculating dose distributions in small tissue phantoms irradiated with neutron beams having energies in the 0.4-100 GeV range are presented.

31957 CALCULATION OF THE DISTRIBUTION OF ABSORBED POSITRONS FROM ^{22}Na IN MATTER. Vorob'ev, A. A.; Kuz'minykh, V. A.; Vorob'ev, S. A. Prikl. Yad. Spektrosk.; No. 5, 6-10(1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1973).

Equations to describe the differential and integral characteristics of a field of scattered positrons in matter were derived by means of the mean free path model, characterized by simple calculation algorithms on the basis of the transformation of transport equations to a system of recursion relations. Curves for the distribution of the absorbed positrons and the distribution of the lost energy of the positrons were calculated for different materials. (JSR)

31958 EXPERIMENTAL DETERMINATION OF THE AVERAGE ENERGY NECESSARY FOR THE PRODUCTION OF AN ION PAIR IN AIR. Guiho, J. P.; Simoen, J. P. (CEN de Saclay, Gif-sur-Yvette, France). Int. J. Appl. Radiat. Isot.; 26: No. 12, 714-719 (1975). (In French).

The determination of the average energy $\bar{W}_a$ necessary to form an ion pair in air in a ^{60}Co beam (which is one of the French primary references in dosimetry) is obtained from measurements of the exposure and absorbed doses from the beam in the center of a graphite disc. The differential flux density of the beam having been measured the experimental value of $\bar{W}_a$ is obtained for a mean real photon energy. The so determined value of $\bar{W}_a$ in dry air is: $\bar{W}_a = 33{,}96 \pm 0.34\ JC^{-1}$ for $\bar{E} = 1150$ keV. This result is then compared to different published values. From this comparison the importance of different correcting terms such as the air humidity correction and the carbon/air stopping power ratio, which constitutes the main source of uncertainty, are considered. (auth)

31959 ION-TEMPERATURE MEASUREMENTS OF FISSION-FRAGMENT TRACKS IN CsBr FILMS. Macfarlane, R.D.; Torgerson, D.F. (Department of Chemistry and Cyclotron Institute, Texas A&M University, College Station, Texas 77843). Phys. Rev. Lett. 36: No. 9, 486-488 (1 Mar 1976).

The velocity spectrum of Cs^+ and Br^- ions emitted from thin CsBr films irradiated with fission fragments show that the ions are not ejected by direct collisional interactions with the fission fragments but appear to be thermionically emitted with an average temperature of 6.6×10^4 K. This suggests the existence of a transient hot thermal core within the fission fragment track. Transient fission tracks in condensed phases may be convenient media for studying fast high-temperature atomic and molecular interactions. (auth)

31960 EXPERIMENTAL DETERMINATION OF W FOR OXYGEN IONS IN NITROGEN. Varma, M. N.; Baum, J. W.; Kuehner, A. V. (Brookhaven National Lab., Upton, NY). Phys. Med. Biol.; 20: No. 6, 955-962(Nov 1975).

"Differential" and integral measurements were made of the W value (average energy required to form an ion pair) for oxygen ions in nitrogen gas. A variable pressure cylindrical ionization chamber with a differential pumping section was employed. The average energy deposited per particle in the chamber was determined by integrating the energy spectrum measured with a heavy ion solid state detector. In the integral measurement of W, the particle was completely stopped in the chamber and the total ionization produced in the chamber was measured. The integral W value for 34.5 MeV oxygen ions was found to be 38.6 ± 0.54 eV per ion pair. For "differential" measurements, the pressure in the chamber was raised to 0.003, 1, 5, 15, and 20 Torr; and measurements of ionization currents and average energy deposited per particle were made at each pressure. From differences between these measurements "differential" W was found. The average value of fifteen "differential" W values was found to be 38.6 ± 1.16 eV per ion pair. (auth)

31961 ELECTRON COOLING EXPERIMENTS. Budker, G. I.; Derbenev, Ya. S.; Kikanskii, N. S.; Kudelainen, V. I.; Meshkov, I. N.; Parkhomchuk, V. V. At. Energ. (USSR); 40: No. 1, 49-52(Jan 1976). (In Russian).

The results of electron cooling experiments are described and possible applications of electron cooling in elementary particle physics discussed. (7 figures, 7 references) (auth)

31962 THEORY OF CHANNELING AT SMALL DEPTHS. Kumakhov, M. A. (Inst. of Nuclear Physics, Moscow). Radiat. Eff.; 26: No. 1-2, 43-48(Sep 1975).

A classical theory of channeling of heavy charged particles in a crystal has been developed. The kinetic equations of the Fokker–Planck type and their solutions for the axial and planar channeling with allowance for the inelastic scattering of particles from electrons have been obtained. A detailed analysis of the distribution of particle flux across the channel has been made. The characteristic depths at which statistical equilibrium is established have been determined. (auth)

31963 TRANSMISSION ANISOTROPIES AND STRING SCATTERING OF MeV ELECTRONS AND POSITRONS IN SINGLE CRYSTALS. Neufert, A.; Schiebel, U.; Clausnitzer, G. (Univ., Giessen, Ger.). Radiat. Eff.; 26: No. 1-2, 49-59(Sep 1975).

Electron and positron transmission experiments have been performed on MgO and Si single crystals with energies between 5 and 45 MeV. The measured axial directional effects can be interpreted in terms of the classical continuum model of positive ion channeling, if particle deflections caused by string scattering are taken into account. The influence of crystal thickness and particle energy are understood qualitatively by these classical theoretical considerations. Computer calculations were performed to give a quantitative comparison of the classical theory with experimental electron transmission profiles. Fine structure due to diffraction effects has been observed in angular distributions of electrons and positrons up to particle energies of 15 MeV. (auth)

31964 SPECTRA AND DOSIMETRY OF NEUTRONS FROM MODERATION OF ^{235}U AND ^{252}Cf FISSION SOURCES IN H_2O. Ing, H.; Cross, W. G. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Health Phys.; 29: No. 6, 839-851(Dec 1975).

Spectra from Monte Carlo calculations are presented for neutrons from fission of ^{235}U and spontaneous fission of ^{252}Cf after moderation by various thicknesses of water up to 50 cm. For ^{235}U, the source was located at the center of spheres, distributed uniformly throughout spheres and in the form of a collimated beam incident on water slabs. Changes in spectral shape with water thickness, source geometry and detector location are discussed with reference to spectral models used for determining neutron dose from readings of neutron detectors. For ^{252}Cf, spectra were computed only with the source at the center of water spheres. These calculations provide standard fluences of different average energies for calibration of neutron dosimeters and for checking mean cross-sections of various nuclear reactions. Effective cross sections ($\bar{\sigma}$) for threshold detectors ^{103}Rh, ^{115}In, ^{32}S, ^{237}Np, ^{232}Th and ^{238}U were obtained by averaging the cross sections over the calculated spectra. Average kerma ($\bar{K}$), dose equivalent and maximum dose per neutron/cm^2 were also calculated. Curves of $\bar{\sigma}$, $\bar{K}$ and $\bar{\sigma}/\bar{K}$ show the sensitivity of these detectors to changes in the fission spectrum from water moderation and also permit the computation of correction factors to dosimeter readings. Of the detectors studied, the dose responses of Np and Rh were most nearly independent (± 10%) of spectral changes. (auth)

31965 HIT CROSS-SECTIONS IN SINGLE TARGET THEORY. Watt, D. E. (Dundee Univ., Eng.). Phys. Med. Biol.; 20: No. 6, 944-954(Nov 1975).

A theoretical single target, single or multi-hit model for the biological effect cross-section for charged particles and gamma rays was expressed in terms of the fundamental physical interaction cross-sections. The model allowed for the chemical action of the fragments and included correction for saturation effects. An interesting conclusion, based on very limited experimental evidence, was that there are prospects of constructing a new system of radiation dosimetry with only two significant parameters; the effective volume of the target and the concentration of events. No energy parameters are necessary. (auth)

31966 SPECTRA AND DOSIMETRY RELATED TO NEUTRON IRRADIATIONS OF THE HUMAN BODY. Ing, H.; Cross, W. G. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Med. Biol.; 20: No. 6, 906-917(Nov 1975).

Neutron spectra at various locations in a phantom, irradiated by collimated beams of 14 MeV neutrons and neutrons from ^{252}Cf and Po-Be sources, were calculated using the Monte Carlo technique. These spectra gave an indication of the distortion in source spectra associated with neutron irradiations of the body for therapeutic and diagnostic purposes. The effect of the spectral distortions on the dose response of several activation and damage track detectors was investigated. Of the dosemeters studied, Np had a dose response most nearly independent (± 10%) of the spectral changes. (auth)

31967 QUANTITY TO BE MEASURED WITH BETA-RAY DOSEMETERS. Reich, H.; Boehm, J. (Physikalish-Technische Bundesanstalt, Braunschweig, Ger.). Phys. Med. Biol.; 20: No. 6, 1031-1035(Nov 1975).

Arguments are presented in favour of the adoption of the absorbed dose rate in standard soft tissue at a certain depth in tissue, $\dot{D}_t$, rather than the absorbed dose rate "to air free in air," $\dot{D}_a$, as the quantity in terms of which beta-ray dosemeters are calibrated. This quantity should as far as possible meet practical needs for field instruments, and there is no need to use the same quantity for both primary standards and field instruments linked by a calibration chain. The international compatibility of measurements is warranted if only the conversion factors are uniquely defined and stated in the accompanying documents. In the case of beta rays a primary standard, based on the extrapolation chamber principle is suitable, but the "free air" measurement as proposed by the BCRU may also be used. Field instruments for beta rays should be constructed to indicate the quantity "absorbed dose, or dose rate, in tissue at a defined depth below the surface." (UK)

31968 APPROACH TO MICRODOSIMETRY IN A π^- MESON BEAM USING NUCLEAR EMULSIONS. Kember, N. F.; Smith, F. A.; Perris, A. G. (St. Bartholomew's Hospital, London). Phys. Med. Biol.; 20: No. 6, 918-925(Nov 1975).

K5 emulsions 10 μm thick were exposed at various depths in a perspex phantom to a 70 MeV π^- meson beam and counts taken of the tracks in emulsion volumes $7 \times 7 \times 10\ \mu m^3$. Data are presented on the number of track events and also the total number of grains associated with each event in each of four categories spanning the LET range of the secondary particles. The number of heavy tracks (category 4) showed an increased incidence in the region of the stopping π^- mesons (14.5 cm in perspex) while the number of single grains (category 1) decreased with depth. Categories 2 and 3 (grain clusters and light tracks) were approximately constant with depth. An estimate of the grain sensitivity was obtained by taking the proton as representative of the whole range of secondary particles. This procedure gave a value of 5 keV per grain in the π^- peak. The LET of light tracks was therefore in the range 1 to 10 keV μm^{-1} in emulsion, scaling to 0.4 to 4 keV μm^{-1} in water. Heavy tracks had LET values in excess of 4 keV μm^{-1} in water. (auth)

31969 14 MeV NEUTRON DOSIMETRY IN BIOLOGICAL MEDIA. Fearon, T. C. Rochester, NY; Univ. of Rochester (1975). 110p. University Microfilms Order No. 75-24,455.

Thesis (Ph. D.).

Neutron energy spectra and fractional absorbed dose distributions in LET of a 14 MeV neutron beam have been obtained as a function of depth in a tissue equivalent liquid phantom. Threshold activation foils were used in the energy spectral determinations and a Rossi type proportional counter for the LET dose distributions. The effect of an inhomogeneity in the phantom was also examined. Results indicated a shift to lower energies in the neutron energy spectra as a function of depth in the phantom and behind a bone plastic plane interface. The absorbed dose distribution in LET showed modification mainly of the proton component with a decrease in the dose average LET. The interface led to an increase of the dose average LET. (Diss. Abstr. Int., B)

31970 MEASUREMENT OF THE ENERGY LOSS IN THIN SILICON SINGLE CRYSTALS. Goetz, G.; Klinge, K. D.; Schwabe, F. (Friedrich-Schiller-Universitaet, Jena (German Democratic Republic). Sektion Physik). Exp. Tech. Phys.; 23: No. 2, 167-179(1975). (In German)

Energy loss and dechanneling of ion beams in dependence of the angle of incidence to crystal axes or planes are a necessary presupposition for the channeling effect technique. Such measurements were made with protons on thin (1-4 μm) silicon single crystals with a backscattering technique. At the back of crystalline targets very thin layers of carbon or LiF were deposited. Backscattering of the protons on these layers and on the silicon targets was used for the measurement of the energy loss ratio $d = (dE/dt)_{hkl}/(dE/dt)_{random}$ for the penetrating protons and the backscattered protons respectively.

31971 DOSIMETRY CONSIDERATIONS IN CYCLOTRON-PRODUCED ^{99m}Tc. Barnes, W. E. (Veterans Administration Hospital, Hines, Ill. (USA)); Colombetti, L. G. (Michael Reese Hospital, Chicago, Ill. (USA)). Radiol. Diagn.; 16: No. 1, 9-15 (1975).

The radiation dose to the patient from radionuclide impurities present in ^{99m}Tc produced in the cyclotron has been calculated. Impurity levels used in the calculations were derived from published γ-ray spectrographic measurement of ^{99m}Tc directly produced in the bombardment of 97.42% ^{100}Mo by 22 MeV protons. The radiation dose to target organs, relative to that ^{99m}Tc, contributed by radioisotopic impurities is significant: Total body (28%), Thyroid (22%), Stomach (24%), Small Intestine (34%), Upper Large Intestine (26%), Lower Large Intestine (23%), Kidney (23%), Bladder (24%). Principal radionuclide impurities contributing to the radiation dose were: ^{93}Tc, ^{94}Tc, ^{94m}Tc, ^{95}Tc, ^{96}Tc. The use of ^{100}Mo target material isotopically enriched to 99.9% which may become available in the future would reduce the impurity radiation dose to the total body to 0.04% level. (GC)

31972 INDUCED ^{24}Na ACTIVITY AS A NEUTRON DOSEMETER. Hermanska, J. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). Fakulta Jaderna a Fysikalne Inzenyrska). Acta Polytech. (Prague), IV; No. 5, 117-122(1973). (In Czech)

From 2nd scientific conference of the Czech Technical University; Prague, Czechoslovakia (12 Jun 1973).

A method of determining neutron doses based on the measurement of induced ^{24}Na activity in mice irradiated by a nuclear reactor is described. The mice and phantoms thereof were irradiated for over 2.5, 10, and 20 hours in the TK-11 vertical channel. Two hours long irradiation of the experimental objects resulted in a specific activity of $a = (6.298 \pm 0.974) \times 10^{-4}$ μCi ^{24}Na/mg ^{23}Na; neutron dose corresponded to $D_n = (8.05 \pm 1.132)$ rads. (auth)

31973 FUNCTIONAL ANALYTIC APPROACH TO MULTIGROUP TRANSPORT THEORY. Sancaktar, S. Blacksburg, VA; Virginia Polytechnic Inst. and State Univ. (1976). 113p. University Microfilms Order No. 76-3869.

Thesis (Ph. D.).

A functional analytic method which was first introduced by Larsen and Habetler for the one-speed isotropic case in 1973 is applied to full and half-space multigroup problems in one dimension with a constant and invertible transfer matrix. The Case-type eigenfunction expansion formulas for the solutions of these problems are explicitly obtained. For the half-space case, the formulas are expressed in terms of two matrices X and Y which provide the Wiener–Hopf factorization of the dispersion matrix. The method applied yields compact results avoiding the calculation of adjoint solutions and normalization integrals to determine the expansion coefficients. Since the method proves to be amenable to further generalization, the case of a degenerate transfer kernel is also considered along the same lines, yielding the expansion formulas for that problem in the full and half-space cases. The expansion formulas are shown to be valid at least for subcritical media, but an extension to critical problems is expected. (Diss. Abstr. Int., B)

31974 TWO-PHOTON VACUUM SYNCHROTRON EMISSION. Skobelev, V.V. Opt. Spectrosc. (USSR) 39: No. 6, 667-668 (Dec 1975).

Another consequence of nonlinear electrodynamics, vacuum synchrotron emission, is discussed. Expressions are derived for the integrated intensity and probability of the emission, and the spectral-angular characteristics are studied. The possibility of an experimental observation of the phenomenon is indicated. (auth)

31975 PORTABLE TISSUE EQUIVALENT CALORIMETER. McDonald, J.C.; Laughlin, J.S.; Freeman, R.E. (Biophysics Laboratory, Memorial Sloan-Kettering Cancer Center, 1275 York Avenue, New York, New York 10021). Med. Phys. 3: No. 2, 80-86 (Mar 1976).

A portable tissue equivalent calorimeter has been constructed and employed to measure absorbed dose in a mixed fast-neutron and gamma-ray field. Design details and measurement techniques are described along with the limits of precision and absolute accuracy. Experiments have been carried out with a cyclotron produced neutron beam using the ^{9}Be(d,n)^{10}Be reaction at dose rates ranging from 3 to 25 rad/min. A series of ten measurements at a dose rate of approximately 10 rad/min were performed with a precision of $\pm$2% (standard deviation about the mean). The compact design of this calorimetric system facilitates transport to other laboratories for the measurement of absorbed dose in several complex radiation fields. (auth)

31976 DISPLACEMENT CORRECTION FACTOR FOR FAST-NEUTRON DOSIMETRY IN A TISSUE-EQUIVALENT PHANTOM. Shapiro, P.; Attix, F.H.; August L.S.; Theus, R.B. (Naval Research Laboratory, Washington, DC 20375); Rogers, C.C. Med. Phys. 3: No. 2, 87-90 (Mar 1976).

The displacement correction factor to be used for analysis of fast-neutron dosimetric measurements using air-filled EG and G tissue-equivalent ion chambers in a tissue-equivalent phantom has been investigated using the MANTA neutron radiotherapy beam generated by 35-MeV deuterons on a thick Be target. The displacement correction factor inferred from these measurements is 0.970 for the EG and G IC-17 (1.0-cm^3) ion chamber, and is 0.989 for the EG and G IC-18 (0.1-cm^3) ion chamber. This multiplicative displacement correction factor has no significant dependence on depth in the phantom or on neutron beam size. (auth)

31977 SPECIFICATION OF ELECTRON BEAM QUALITY FROM THE CENTRAL-AXIS DEPTH ABSORBED-DOSE DISTRIBUTION. Brahme, A. (Institute of Radiation Physics, Fack, S-104 01 Stockholm, Sweden); Svensson, H. Med. Phys. 3: No. 2, 95-102 (Mar 1976).

The distribution of absorbed dose in a medium irradiated by broad electron beams has been analyzed from physical and therapeutic points of view. A number of parameters which describe the beam quality and the shape of the absorbed-dose distribution along the central axis are defined. Several comparisons are made of the values of these parameters obtained from measurements made on different therapy accelerators and from theoretically calculated dose distributions for monoenergetic and monodirectional beams. It is found that the major part of the observed differences between experimental and theoretical results can be attributed to the energy distribution of the accelerator beam and to processes in the scattering material, such as energy straggling and the production of secondary electrons and photons. A simple expression is derived relating the slower falloff in dose found for most accelerator beams to the large energy spread found in these beams. Further, a semiempirical relationship is found which makes it possible to obtain the mean electron energy at the phantom surface from the depth where the absorbed dose has decreased to 50% of its maximum value along the central axis. (auth)

31978 UNEQUAL WEIGHTING OF GIVEN DOSES IN OPPOSED FIELDS IN TREATMENT OF CANCER OF THE TONSILLAR REGION USING ^{60}Co, 4-, 8-, 15-, 24-MVp PHOTONS. Wollin, M.; Gilbert, H.A.; Kagan, A.R. (Department of Radiotherapy, Southern California Permanente, Medical Group and Kaiser Foundation Hospital, Los Angeles, California 90027). Med. Phys. 3: No. 2, 113-116 (Mar 1976).

Weighting of given doses from parallel opposed fields is a widespread practice in radiation therapy of cancer in the tonsillar region. In order to determine when weighting is useful, dose distributions on the central axis were calculated for various energies (^{60}Co, 4-, 8-, 15-, and 24-MVp photons), weighting factors, and field separations. Criteria for judging the usefulness of weighting were (i) that variation in the dose across the tumor volume not exceed 10%, and (ii) that the dose to critical tissues outside the target volume be at least 20% less than target volume dose. The clinical situation that met these criteria was a lateral lesion that extended to less than one-third of the transverse diameter of the head, treated with either ^{60}Co, 8, or 4 MVp with 4:1 weighting. Under these conditions, weighting was considered to be justified. (auth)

31979 DOSIMETRY OF ^{137}Cs SOURCES WITH THE FLETCHER-SUIT GYNECOLOGICAL APPLICATOR. Saylor, W.L.; Dillard, M. (Department of Radiology, University of North Carolina, Chapel Hill, North Carolina 27514). Med. Phys. 3: No. 2, 117-119 (Mar 1976).

Measurements were made in water about the tandem and ovoid structures of the Fletcher–Suit applicator loaded with a ^{137}Cs source. The dose rate was found to vary as much as 25% as a result of differential absorption in the ovoid. Empirically based trigonometric expressions are suggested which provide the absorption correction as a function of the two angles of a spherical coordinate system. Computer-calculate dose rates, with and without the absorption corrections, are compared. (auth)

31980 SCATTER MEASUREMENTS IN A WATER PHANTOM AND ATTENUATION MEASUREMENTS FOR VARIOUS MATE-

RIALS FOR 15 MeV NEUTRON BEAMS. Cytacki, E. P. Madison, WI; Univ. of Wisconsin (1975). 189p. University Microfilms Order No. 75-18,585.

Thesis (Ph. D.).

Two sources of extraneous radiotherapy patient dose for 15-MeV neutron beams are examined: shield (collimator) transmission and patient scatter. The neutrons were produced via the $^3H(d,n)^4He$ reaction by bombarding a thick tritium target with 200-keV deuterons. Good geometry attenuation measurements were measured as a function of thickness for steel, polyethylene, water, lead and cerrobend (a low melting point bismuth alloy used for beam shaping in cancer radiotherapy). Steel was the best attenuator per length; and water, the worst. Lead and cerrobend gave nearly the same results. The ratio of scatter to primary for a steel shield 15 cm from the detector was three times the scatter to primary ratio for a polyethylene shield of the same thickness and distance from the detector. Patient scatter was determined by measuring neutrons scattered to points outside of collimated neutron beams which were incident on a 30 x 20 x 24 cm^3 water phantom located 125 cm from the neutron source. Electronic collimation eliminated room scatter and collimator scattered neutrons from the measurements. From these experiments it can be concluded that electronically collimated neutron beams can be used only as a preliminary means of evaluating materials for radiotherapy shielding because of the large fraction of scattered neutrons which are not measured by this technique that emerge from the shields. It was seen that the neutrons in the penumbra of a 50 cm thick steel/polyethylene collimator would contribute twice as much neutron dose to a point 10 cm outside of a 13 x 13 cm^2 neutron beam at 10 cm depth than the patient scatter dose at the same point. A 75 cm thick collimator would reduce the neutron dose from the collimator penumbra to approximately the same level as the patient scatter dose at this point. (Diss. Abstr. Int., B)

31981 TRANSMISSION OF GAMMA RADIATION THROUGH FINITE CYLINDRICAL BARRIERS. Elias, E.; Segal, Y.; Notea, A. (Technion-Israel Inst. of Tech., Haifa). Nucl. Technol.; 28: No. 2, 261-269(Feb 1976).

The properties of energy distributions resulting from transmission of gamma rays through finite cylindrical barriers were studied using a modified version of the MORSE Monte Carlo transport code. Systematic studies were carried out to investigate the effects of density, composition, source energy, and cylinder diameter on the scattered and unscattered flux. In addition the average number of collisions and the contribution of the single-, double-, and triple-scattered photons were calculated for each run. It was found that for the same energy group, the intensity of the scattered flux reaches a maximum at a density that depended directly on the leakage probability but only slightly on composition. The correspondence between the Monte Carlo simulation and experimental results was found to be good. (auth)

31982 CORRECTIONS FOR X-RAY POLYCHROMATICITY EFFECTS ON THREE-DIMENSIONAL RECONSTRUCTION. Pang, S. C.; Genna, S. (Veterans Administration Hospital, Boston). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 623-626(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The effect of polychromaticity on the reconstruction of attenuation coefficients from x-ray transmissions is presented by computer simulations of two simple phantoms. The distortions resulting from different amounts of x-ray beam hardening along different paths can be reduced by an equivalent water path analysis and a two parameter energy independent analysis. The first method transforms the projected paths into equivalent (i.e., same total transmission) water path lengths. The second method uses two spectra to factor out the energy independent parts of the photoelectric and Compton coefficients. This solution also involves conversion into equivalent water path lengths. (auth)

31983 QUASI-UNIFORM IRRADIATION OF PLANE SURFACES USING MULTIPLE RADIATION SOURCES. Clark, R. W.; Freiwald, D. A. (Los Alamos Scientific Lab., NM). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 827-832(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The question of the optimum location of multiple radiation sources for quasi-uniform irradiation of plane surfaces is addressed, and the problem is studied numerically for the case of a square plane target surface and plane arrays of equal spherically symmetric (4 pi) radiation sources. The technique presented is also applicable to non-planar source arrays and non-planar targets as well as to the case of sources whose radiation pattern is not spherically symmetric. The square target problem is solved numerically for the case where the desired target surface flux uniformity is 80 percent. The optimum source location coordinates and the resulting target flux patterns are presented for a number of source arrays. The scaling with the number of sources used and the distance between the source and target planes is also given. The results show that a significant reduction in the total source strength required to produce a given quasi-uniform target fluence can be achieved by using multiple sources. For example, for an 80 percent uniformity constraint, four properly placed sources, S/sub o/, are found to give approximately 19 times the average flux from a single source of strength S/sub o/. This represents a gain factor of approximately 4.76 due to better utilization of the available source strength. Calculations show that gains in excess of an order of magnitude can be achieved in this manner by using a large number of properly placed sources. (auth)

31984 STRAGGLING OF HEAVY IONS IN ALUMINUM. Kane, P. P. (Indian Inst. of Tech., Bombay); Freeman, J. M.; Petty, R. J. pp 293-296 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Department of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974).

Pulse height distributions from direct and straggled oxygen ions in aluminum are presented from an experimental investigation of heavy ion straggling. (JFP)

31985 MEASUREMENT OF PROJECTED RANGE OF CHARGED PARTICLES BY RADIATION BLISTERING. Luthra, J. M. (Bhabha Atomic Research Centre, Trombay, India). pp 306-308 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Department of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974).

A description is given of how the radiation blistering can be used to determine the projected range of gaseous charged particles in solids. The energy loss and stopping power curves are plotted. (JFP)

31986 SKY-SHINE SPECTRA OF ^{60}Co SOURCE. Swarup, J.; Ganguly, A. K. (Bhabha Atomic Research Centre, Bombay). Indian J. Pure Appl. Phys.; 13: No. 9, 595-598(Sep 1975).

Preliminary results obtained on the sky-shine spectra from a 650 Ci ^{60}Co source placed at the center of a γ irradiation field (90 m radius) fenced by a stone wall, are reported. It is found that the spectrum extends up to 400 keV with a pronounced peak at 72 keV for all the distances. There is no evidence of the presence of primary γ-photons in the spectra. Total counts under the sky-shine are observed to follow an exponential decline with increase in distance, with a slope of -0.50 ± 0.02 for both the collimators used. The ratio of peak counts (72 keV) to total sky-shine is 0.24 ± 0.02 for both the collimators. Also, the nature and intensity of the spectra remain unchanged when the lead shield around the detector is provided with an internal lining of 2.5 cm thick aluminium. (auth)

31987 CALCULATION OF BREMSSTRAHLUNG SPECTRA AT VARIOUS ANGLES IN THE 1 TO 30 MeV RANGE. Zhuchko, V. E.; Tsipenyuk, Yu. M. Sov. At. Energy (Engl. Transl.); 39: No. 1, 643-645(Jul 1975).

Translated from At. Energ.; 39: No. 1, 66-68(Jul 1975).

A formula is presented for the forward bremsstrahlung spectrum from a thick target, and the calculated values for aluminum are compared with experimental values for 20.9 MeV electrons. The calculations are extended to give spectral shape at various forward angles. 4 figs. (GHT)

Radiation Protection Standards

Refer also to abstracts 29665, 29666, and 29943.

31988 (RPB-SC-10) INSTALLATION AND SAFETY PROCEDURES FOR THE USE OF X-RAYS IN MEDICAL THERAPY. (Department of National Health and Welfare, Ottawa, Ontario (Canada). Radiation Protection Div.). Dec 1974. 67p. INIS.

Procedures, installation arrangements and safety facilities detailed in this code are for the instruction and guidance of all persons coming under the jurisdiction of the Federal Treasury Board Standards and Canada Labour (Safety) Code, using equipment that produces X-rays for medical therapy. Also included in this code are advisory sections for the specific guidance of (1) the radiotherapist, (2) the radiological physicist concerned with calibration procedures, equipment performance and protection surveys, and (3) the equipment designer and manufacturer. (auth)

31989 (ZVU-P-1353) X-RAY PROTECTION. 1. (Zavody Vitezneho Unora, Hradec Kralove (Czechoslovakia)). [nd]. 12p. (In Czech). INIS.

Translated from X-inf. (1969).(no.13) p. 1-8 from FL Industrial X Ray Division, Balteau, Belgium. Available by Trust Podniku Chepos, Hradec Kralove (Czechoslovakia). Zavody Vitezneho Unora.

Practical instructions are presented for the protection against radiation of personnel handling industrial X-ray apparatus. The instructions are specified according to the possible equipment applied. Tabulated are data on absorption thicknesses of various materials and on corresponding distances from X-ray sources. (INIS)

31990 RELATIONSHIP BETWEEN LEGAL RADIATION PROTECTION SPECIFICATIONS AND TECHNICAL STANDARDS IN RADIOLOGICAL TECHNOLOGY. Berger, H. (Siemens A. G., Erlangen (F. R. Germany). Unternehmensbereich Medizinische Technik). DIN-Mitt.; 54: No. 1, 8-10(Jan 1975). (In German).

The radiation protection regulation in the radiological technology has a long tradition as the danger of ionizing radiation was known from the start. The first radiation protection regulations were worked out by specialist commissions of scientific societies. They were generally recognized. The article outlines the efforts, also on an international level, to achieve uniform definitions which is not easy with the multiple methods and equipment. The settlement by standardization and the efforts of the national and international standards organizations are especially dealt with, where an essential factor is to find a harmony between the technical standards and the legal standards. (DE)

31991 NEW SPECIAL NAMES OF SI UNITS IN THE FIELD OF IONIZING RADIATIONS. Liden, K. (University Hospital, Lund, Sweden). Phys. Med. Biol.; 20: No. 6, 1029-1030(Nov 1975).

The resolutions adopted by the 15th General Conference of Weights and Measures (CGPM) following recommendations from ICRU are reported and discussed. ICRU had recommended the adoption of special names for the SI unit the joule per kilogram, Jkg^{-1}, when applied to absorbed dose and related quantities and for the SI unit the reciprocal second, S^{-1}, when applied to the quantity activity as a measure of the rate of spontaneous nuclear transformation of radioactive nuclides. The SI unit Jkg^{-1} is now given the name gray with the symbol Gy when used for ionizing radiation (absorbed dose, kerma, specific energy imparted, etc.); 1 Gy = 100 rad = 1 Jkg^{-1}. The SI unit S^{-1} (one per second) for activity is given the name becquerel, symbol Bq; 1 Bq = 1 $S^{-1} \approx 2.703 \times 10^{-11}$ Ci. ICRU now recommends that the special units the rad, the röntgen and the curie be gradually abandoned over a period of not less than about 10 years and replaced by the SI units the gray (Gy), the coulomb per kilogram (Ckg^{-1}) and the becquerel (Bq) respectively. Preparatory steps should be taken as soon as possible in order to facilitate a smooth, safe and efficient transition. ICRU has decided that the physical dimension of the quantity dose equivalent shall be the same as for absorbed dose (1973, Dose Equivalent, Supplement to ICRU Report 19, ICRU Publications, PO Box 30165, Washington, DC 20014, USA). The formulation of a proper set of quantities and units for dose equivalent remains a special problem, which is of particular importance in the field of radiation protection. (UK)

31992 APPROACH TO THE SURVEYING OF RADIATION ENVIRONMENTS FOR RADIATION PROTECTION PURPOSES. Harvey, J. R. (CNRS, Marseille). Phys. Med. Biol.; 20: No. 6, 1003-1014(Nov 1975).

Many of the inadequacies of the system presently used for surveying environments containing penetrating radiation stem from the impossibility of defining a radiation parameter which is additive, measurable, and closely related to peak dose equivalent in the body. Many of the present conceptual difficulties would be eliminated if surveys were made in terms of quantity "dose equivalent ceiling" defined as the sum of the peak dose equivalents generated by all the components of the field if each were incident normally to the front face of an anthropomorphic phantom. "Dose equivalent ceiling" is close to the quantity measured by existing instruments, is both additive and measurable, and can be rigorously related to primary radiation field quantities. It is always greater than peak dose equivalent in the body and would be used to define an exposure period during which a given dose equivalent could not be exceeded. The dose to specific parts of the person's body would then be estimated by personal dosimetry. Fields of low penetrating radiation could continue to be surveyed in terms of dose to specific superficial organs. Dose equivalent ceiling, which corresponds to the instrumental measurement, exceeds dose equivalent index, an indication of peak dose equivalent in the body, by a factor which can be as large as six. (auth)

31993 FURTHER RESULTS IN NUCLEAR SCATTERING RADIOGRAPHY. Charpak, G.; Dubal, L.; Majewski, S.; Perrin, Y.; Saudinos, J.; Sauli, F.; Townsend, D.; Vinciarelli, J. (CERN, Geneva). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 590-593(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The work has shown that nuclear scattering radiography (NSR), is capable of a three-dimensional measurement of density distributions with a volume resolution of about 2 mm^3 in objects of a size similar to that of a human head. Hydrogen radiographies are possible in addition to radiographies sensitive to density or atomic distribution. It is planned to make experiments under conditions of beam intensity and data rates compatible with full use of the potential advantages of the method for radiographies of living bodies.

Radiation Source Calibration and Standardization

31994 DETERMINATION OF TISSUE SCATTERING FRACTION AND OPTIMUM ADJUSTMENT OF PULSE HEIGHT ANALYZER FOR THE NUCLIDE ^{99m}Tc. Ertl, S. (Staedtische Klinik, Berlin). Radiobiol. Radiother.; 16: No. 6, 745-753(1975). (In German).

The dependence of the scattering fraction on the lower discriminator threshold for the analyzer and on the size of a volume source for the nuclide ^{99m}Tc was determined. For that purpose spectra of different large volume sources were recorded and determined by means of a calculated scattering spectrum of the photopeak due to unscattered radiation. For the determination of the optimum adjustment of the analyzer an objective criterion is used. The compromise between the reduction of the scattering fraction S and the maximum counting effectivity ψ for unscattered radiation is considered optimum when the factor $(1 + S)/\psi$ in dependence on the lower discriminator threshold becomes a minimum. For ^{99m}Tc the optimum discriminator adjustment is 128 kev for the detector used in this examination. (auth)

31995 NOTES ABOUT ^{51}Cr–^{59}Fe DOUBLE-NUCLIDE MEASUREMENTS. Mischke, W. (Staedtische Klinik, Berlin). Radiobiol. Radiother.; 16: No. 6, 803-807(1975). (In German).

Spectra of the nuclide ^{59}Fe are given which were determined for different scattering ratios and source geometries. By means of these spectra a comparison of counting rates in the Cr channel (290–360 kev) is made when in the ^{59}Fe channel (1,000–1,370 kev) the same results of counting are obtained. For a screening-collimator unit isopulse curves and characteristic collimator curves for the nuclides ^{51}Cr and ^{59}Fe are given. (auth)

31996 VARIATION IN OUTPUT WITH A FIXED DOSE SETTING ON A 4-MV LINEAR ACCELERATOR. Gillin, M.; Quillin, R. (Walter Reed Army Medical Center, Washington DC 20012). Med. Phys. 3: No. 2, 107-108 (Mar 1976).

Variations in the output with a fixed monitor unit setting as a function of magnetron power of a 4-MV linear accelerator has been studied. The relationship between radiation output and monitor units was found to vary by as much as 10%. The central-axis depth dose was found to remain constant within experimental error. Field flatness measurements indicated that for lower power outputs, the radiation field was less flat than for higher power outputs. A mechanism for the change in calibration is suggested based upon field flatness measurements. (auth)

31997 DEPENDENCE OF SCATTERED γ-RAY BUILDUP FACTOR ON RADIUS OF CYLINDRICAL SHIELDING BLOCKS IN A SCATTERING MEDIUM. Broder, D. L.; Kozlovskii, S. A.; Kulikov, V. I.; Kuchin, N. L.; Popkov, K. K.; Trofimov, I. N. Sov. At. Energy (Engl. Transl.); 38: No. 3, 214-216(Mar 1975).

Translated from At. Energ.; 38: No. 3, 170-171(Mar 1975).

The dependence of the scattered γ-ray buildup factor on the radius of a cylindrical shielding block located in a medium different in physical properties from the block material was investigated experimentally and an empirical formula proposed describing this dependence by means of the buildup factor for the block material and a combination of the albedo of the block material and of the surrounding medium. This recommendation was confirmed by experiments using γ-ray sources having a maximum energy $E_0 = 1.25$ MeV for cylindrical blocks no more than $5\,\mu^{-1}$ long. The formula mentioned is investigated over a broader range of γ-ray energies and also for blocks with a length $1 \leq 15\,\mu^{-1}$. The studies were carried out by means of Monte-Carlo calculations on an M-220 computer using the program employed previously. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 29434, 31649, and 31950.

31998 (EUR-5286) THE ANGULAR FLUX OF GAMMA RAYS IN A NORMAL CONCRETE SHIELD. Penkuhn, H. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Dec 1974. 18p, INIS.

The angular dependence of the photon energy and dose rate flux in an ordinary concrete slab shield is fitted near the shield axis by a power of the directional cosine $\omega = \cos\phi$. The exponents found are strongly space-dependent. For large ϕ further fits are given. The source energy range from 0.7 MeV to 6 MeV and penetrations of 12.5 cm $\leq x \leq$ 200 cm are considered. (auth)

31999 (ZVU-P-1356) PROTECTION. 2. Method of Calculation. (Nauchno-Izsledovatelski Inst. po Radiologiya i Radiatsionna Khigiena, Sofia (Bulgaria)). [nd]. 16p. (In Czech). INIS.

6 figs., 3 tables; translated from X-inf. (1969). (No. 16) p. 1-8 by FL Industrial X Ray Division, Balteau, Belgium. Available by Trust Podniku Chepos, Hradec Kralove (Czechoslovakia). Zavody Vitezneho Unora.

The method is described of calculating the thickness of lead, concrete and other absorption materials for X-ray protection purposes, set by the French standard NFC 15/160 of 1958.

32000 DIGITAL METHOD FOR MEASUREMENT OF γ-RAY ATTENUATION COEFFICIENT. Ramani (Bangalore Univ., India); Puttaswamy, N. G.; Adiga, B. S.; Sankaranarayanan, P. E. Indian J. Pure Appl. Phys.; 13: No. 5, 316-318(May 1975).

A digital method for the measurement of total attenuation coefficient of materials for γ rays is described. The method is suitable when the thickness of the absorber involved is small. The system described is all digital and the display indicates directly the value of the total attenuation coefficient. (auth)

32001 EXPERIMENTAL X-RAY ATTENUATION COEFFICIENTS AT LOW PHOTON ENERGIES FOR SUBSTANCES OF MEDICAL IMPORTANCE. Miller, R. H. (Royal Infirmary, Edinburgh). Phys. Med. Biol.; 20: No. 6, 974-979(Nov 1975).

Recent experimental values of X-ray mass attenuation coefficients for the elements Z = 6 to Z = 18 in the energy range from 4 to 25 keV suggested improvements to the data set presented in the ICRU Report 17 (1970, Radiation Dosimetry: X rays generated at potentials of 5 to 150 kV, ICRU Publications, Washington, D. C.). The results were, however, in excellent agreement with the theoretical data of Storm and Israel (Storm, E., and Israel, H. I., 1970, Nuclear Data Tables, A7). Values of mass attenuation coefficient for these elements and for a selection of materials of medical and biological importance are presented. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 31090, 31192, 31207–31211, 31359, 31974, and 32128.

32002 (CRN-HE-74-18) RECENT TRIALS TO VERIFY QUANTUM MECHANICS. Paty, M. (Centre National de la Recherche Scientifique, 67- Strasbourg (France). Centre de Recherches Nucleaires). 1974. 38p. (In French). INIS.

From colloquium a half century of quantum mechanics; Strasbourg, France (2 May 1974).

An account of the experiments which deal with the verification of Quantum Mechanics and the hidden variable problem is made. First, the well-known EPR paradox is recalled which, in spite of its refutation by Bohr, was the starting point of the questioning on the completeness of Quantum Mechanics and of hidden variable theories; and then Bell's theorem, which shows that the two approaches, Quantum Mechanics and hidden variables, can be put in contradiction. Thereafter the various types of experiments which have been carried out on that subject, mostly concerning the correlation measurements between two photons emitted by a quantum system are described. The most recent experimental results are diverging, some of them to confirm and some others to contradict quantum mechanics. A review of these is given; and a discussion is presented about their possible implications. (FR)

32003 NEW PROOF OF CLOSED FORMULAS FOR BOGOLJUBOV BOSON TRANSFORMATIONS. Kelemen, A. (Frankfurt Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Phys., A; 274: No. 2, 109-111(1975).

4 refs.

The fact that the algebra of the operators b^{+2}, b^2 and $2b^+b + 1$ is closed is utilized for the derivation of closed formulas for Bogoljubov transformations by means of the previously developed technique for treating the angular momentum algebra. (DE)

32004 SOLUTION OF THE SCHROEDINGER EQUATION FOR AN ELECTRON IN A STRONG MAGNETIC FIELD AND A COULOMB FIELD OF THE IONS. El-Khishen, M.; El-Gowhari, A.; El-Lakani, A. (Cairo Univ. (Egypt). Dept. of Physics). Atomkernenergie; 26: No. 4, 265-268(1975).

5 refs.

A general method is developed for the solution of the Schroedinger equation for an electron in a strong magnetic field and in the presence of the coulomb potential of the ions. The solution obtained can be used for radiation processes in the low-frequency region of the emitted radiation. In this article only the solution of the Schroedinger equation is discussed. (DE)

32005 BOUND PHOTONS IN THE LOWEST ORDER WEISSKOPF-WIGNER THEORY. Grimm, E.; Ernst, V. (Muenchen Univ. (F. R. Germany). Sektion Physik). Z. Phys., A; 274: No. 4, 293-303(Oct 1975).

3 figs.; 1 tab.; 27 refs.

The lowest order Weisskopf-Wigner theory of the interaction of a two-level atom with one photon is investigated on a rigorous mathematical base. Within this theory it is shown that the processes of spontaneous emission and resonance fluorescence take place in the conventional way if and only if the energy difference $E(b) - E(a)$ between the upper and the lower level is not too small. If $E(b) - E(a)$ is below a certain, always positive, threshold $\epsilon(ba)$ the hamiltonian of the interacting system assumes an eigenstate. This leads to effects which can be described only by saying that with a certain probability the photon is "bound" to the atom. This is related with a certain binding energy. For the case that the "levels" of the atom are certain interesting states of the Dirac hydrogen atom numerical values are computed for the thresholds, for the binding energies below, and for the line shifts above threshold. Thresholds, binding energies, and line shifts are typically of the order of the experimental Lambshift separation of the $2S_{\frac{1}{2}} - 2P_{\frac{1}{2}}$ level complex. (DE)

32006 MASS TERM IN THE DIRAC ELECTRON THEORY. da Silveira, A. (NEPEC, Rio de Janeiro). Lett. Nuovo Cim.; 15: No. 7, 228-230(14 Feb 1976).

It is observed that if one maintains the traditional Hermitian character of the Hamiltonian operator, there remains only one equation, and the transformation is unitary. Also it is seen that the usual form of the Dirac equation is obtained independently of the tensor character of the additional term. (JFP)

32007 STABILITY OF LINEAR CHAINS WITH THIRD-ORDER ANHARMONICITY. Enz, C. P.; Hongler, M. O.; Quach Thi, C. V. (Univ., Geneva). Helv. Phys. Acta; 48: 787-792(1975).

A n-particle chain with third-order coupling and periodic boundary condition is analyzed with respect to orbital instability (critical energy E_c) and mechanical instability (threshold E_t). For E_c the bounds found for large n are $1/4\alpha^2 \leq E_c \leq 1/\alpha^2$, α being the coupling constant. The bound $E_t \leq 1/\alpha^2$ is found for a configuration which in the continuum limit corresponds to a supersonic (or tachyonic) soliton which, however, is physically not realizable. (auth)

32008 SOLUTION OF THE KORTEWEG–DE VRIES EQUATION IN A HALF-SPACE BOUNDED BY A WALL. Moses, H. E. (Cambridge Research Labs., Hanscom Air Force Base, MA). J. Math. Phys. (N.Y.); 17: No. 1, 73-75(Jan 1976).

A solution of the Korteweg–de Vries equation in the half-space 0 less than r less than infinity with the boundary condition V(0) equals 0 is given. The boundary condition may be interpreted as the requirement that the plane which bounds the half-space be a rigid wall. Aside from possible physical interest, this solution, which is obtained from one of the potentials for the radial Schroedinger equation which do not scatter, appears to indicate that the radial Schroedinger equation and the corresponding Gel'fand–Levitan equation play a role in the case of the half-space bounded by a wall similar to that of the one-dimensional Schroedinger equation (– infinity less than x less than infinity) and its corresponding Gel'fand–Levitan equation in the more usual full space treatment of the KdV equation. A possible interpretation of the solution presented is that it corresponds to the reflection of a wave by a wall, in which the incident wave is singular and the reflected wave is nonsingular but highly dispersive. (auth)

32009 Q-DYNAMICAL SYSTEMS AND CONSTANTS OF MOTION. Marmo, G.; Simoni, A. (Univ., Naples). Lett. Nuovo Cim.; 15: No. 6, 179-184(7 Feb 1976).

An approach, useful in the transition from classical to quantum mechanics and consisting in starting from the algebra of all the observables abstractly given and the configuration space is then reconstructed starting from particular subalgebras of the algebra of all the observables, is used to treat the idea of a dynamical system in classical mechanics. (JFP)

32010 APPROXIMATE SOLUTION OF BOUND STATE PROBLEMS THROUGH CONTINUED FRACTIONS. Garibotti, C. R.; Mignaco, J. A. (Universidad Nacional de Rosario (Argentina). Departamento de Fisica). Z. Phys., A; 274: No. 1, 33-39(Aug 1975).

2 figs.; 7 refs.

A method to solve ordinary linear differential equations through continued fractions is applied to several physical systems. In particular, results for the Schroedinger equation give a good accuracy for the eigenvalues of bound states in the S-wave Yukawa potential, and the lowest order approximations provide exact values for the harmonic oscillator and Coulomb potential eigenvalues and eigenfunctions. (DE)

32011 CALCULATION OF TRANSITIONS IN INTENSE LASER FIELDS WITH THE MAGNUS EXPANSION. Campos, D.; Krueger, H. (Trier–Kaiserslautern Univ., Kaiserslautern (F. R. Germany). Fachbereich Physik). Z. Phys., A; 274: No. 1, 23-25 (Aug 1975).

5 refs.

For bound quantum systems in presence of strong long wavelength electromagnetic fields the time evolution operator is calculated by application of the Magnus expansion in the interaction picture. It is found that the first two orders of the Magnus expansion of the interaction picture time evolution operator contain both the momentum-translation transform of H. R. Reiss and terms which give rise to a non-static Stark-effect. (DE)

32012 ELECTRODYNAMICS AND THE ELECTRON EQUATION OF MOTION. Tabensky, R. (Departmento de Física, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Santiago, Chile). Phys. Rev. D 13: No. 2, 267-273 (15 Jan 1976).

We show the extent to which Lorentz-Dirac equations of motion for the electron follow from Maxwell's equations. The standard derivations depend on cutoff procedures and other prescriptions. The conclusion is that the Lorentz force is cutoff-independent but radiation-reaction forces are not. (auth)

32013 ELECTRODYNAMICS AND THE EQUATIONS OF MOTION FOR CHARGED PARTICLES WITH SPIN. Benguria, R. (Departamento de Física, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Santiago, Chile). Phys. Rev. D 13: No. 2, 274-278 (15 Jan 1976).

We show the extent to which the equations of motion for charged particles with spin, neglecting the radiation-reaction forces, follow from Maxwell equations. The standard derivations depend on cutoff procedures and other prescriptions. The conclusion is that the Lorentz force and the external torque driving the spin are cutoff-independent but other forces driving the particle are not. (auth)

32014 NON-HERMITIAN TIME OPERATORS AND THEIR PHYSICAL INTERPRETATION. Haba, Z.; Nowicki, A.A. (Institute of Theoretical Physics, University of Wroclaw, Wroclaw, Cybulskiego 36, Poland). Phys. Rev. D 13: No. 2, 523-527 (15 Jan 1976).

The problem of localization in time is considered using non-Hermitian time operators. The Hermitian part of these operators is interpreted as time and the imaginary part as dispersion of time. A semi-spectral probabilistic measure on the complex half-plane of the analytically continued time coordinate is proposed. (auth)

32015 SCATTERING OF QUANTIZED SOLITARY WAVES IN THE CUBIC SCHRÖDINGER EQUATION. Dolan, L. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 13: No. 2, 528-530 (15 Jan 1976).

The quantum mechanics for N particles interacting via a δ-function potential in one space dimension and one time dimension is known. The second-quantized description of this system has for its Euler-Lagrange equations of motion the cubic Schrödinger equation. This nonlinear differential equation supports solitary wave solutions. A quantization of these solitons reproduces the weak-coupling limit to the known quantum mechanics. The phase shift for two-body scattering and the energy of the N-body bound state is derived in this approximation. The nonlinear Schrödinger equation is contrasted with the sine-Gordon theory in respect to the ideas which the classical solutions play in the description of the quantum states. (auth)

32016 HYPERVIRIAL THEOREMS FOR THE DIRAC EQUATION. Friar, J.L. (Department of Physics, Brown University, Providence, Rhode Island 02912); Negele, J.W. Phys. Rev. C 13: No. 3, 1338-1340 (Mar 1976).

Diagonal hypervirial theorems are derived for the case of a single bound Dirac particle interacting with a static potential of the vector type. Applications of these relations to the Coulomb problem are discussed. (auth)

32017 MECHANICAL QUANTUM MEASURING PROCESS. Whitten-Wolfe, B. (Miami Univ., Oxford, OH); Emch, G. G. Helv. Phys. Acta; 49: No. 1, 45-55(1976).

A mechanistic analysis of the quantum measuring process is proposed. This takes into account both the reduction of the wave packet and the recording of the measurement on a macroscopic apparatus. An exactly solvable model is given to sustain the theory. (auth)

32018 RELATIVISTIC TWO BODY PROBLEM. Piron, C.; Reuse, F. (Univ., Geneva). Helv. Phys. Acta; 48: 631-638(1975).

The two body problem of relativistic mechanics with scalar interaction is treated in the framework of a canonical formalism which is manifestly covariant. To each solution of the reduced Newtonian two body problem with radial potential, with the one restriction that the speeds stay smaller than the velocity of light, there corresponds in our model a solution differing from the Newtonian one only by a global Lorentz transformation. Other solutions occur which show properly relativistic effects, in particular the potential energy can become bigger than the masses. (auth)

32019 GENERAL THEORY OF POTENTIAL SCATTERING WITH ABSORPTION AT LOCAL SINGULARITIES. Pearson, D. B. (Univ., Geneva). Helv. Phys. Acta; 48: 639-653(1975).

The mathematical theory of potential scattering is generalised to allow real singular potentials for which there is a non-zero probability of absorption of the particle by the scattering center at large (positive or negative) times. That such potentials exist has already been shown by the present author. The usual identification of $M_{a,c}(H)$ with the subspace of scattering states need no longer hold. Instead for each limit $t \to \pm\infty$ we have a canonical decomposition of $M_{a,c}(H)$ into two mutually orthogonal subspaces, one being the scattering subspace and the other consisting of states which are absorbed. The general theory applies equally to short and long range potentials, but for short range potentials the scattering subspaces may be identified with the ranges of corresponding wave operators, which are known to exist even if the potential is highly singular. (auth)

32020 WHEN IS A FIELD THEORY A GENERALIZED FREE FIELD. Baumann, K. (Bell Labs., Holmdel, N. J. (USA); Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Commun. Math. Phys.; 43: No. 3, 221-223 (1975).

It is shown within a scalar relativistic quantum field theory that if either some even truncated n-point-function vanishes or some multiple commutator of the field operators is a c-number then the field is necessarily a generalized free field. (DE)

32021 "VANISHING THEOREM" FOR A POSITIVE HOLOMORPHIC VECTOR BUNDLE OF UNDEFINED RANK. Le Potier, J. (Poitiers Univ., 86 (France)). pp 3 v.; v.3 p.1-12 of Global Analysis and its Applications. Lectures Presented at an International Seminar Course at Trieste from 4 July to 25 August 1972 Organized by the International Centre for Theoretical Physics, Trieste. Vienna; IAEA (1974). (In French)

From international seminar course on global analysis and its applications; Trieste, Italy (4 Jul 1972).

Let M be a compact complex manifold of dimension n and let $E \to M$ be a holomorphic vector bundle over M. Theorem: if E is positive of rank r and if $H^{p,q}(M,E)$ is the cohomology of type (p,q) of M with values in E, then $H^{p,q}(M,E) = 0$ as soon as $p + q \geq n + r$. If $r = 1$, this is the "precise vanishing theorem" due to Kodaira and Nakano; the present paper contains a proof of the general case.

32022 SPHEROIDAL POTENTIALS FOR SCHROEDINGER EQUATION. I. Characterization of a Bound State. Ronveaux, A.; Dumont-Lepage, M. C.; Gerard, R. (Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium)). Ann. Inst. Henri Poincare, Sect. A; 22: No. 4, 291-304(1975). (In French).

Necessary conditions and sufficient conditions in order to insure one bound state of given (l,m) are obtained for spheroidal potentials using the phase approach: the results are valid for potentials function only of one variable. These results reduce asymptotically to the conditions of Jost-Pais and Calogero in the spherical case and can be useful to detect inversion in the introduction of levels of a given potential. (FR)

32023 COMPLETE SET OF ORTHOGONAL SOLUTIONS OF RELATIVISTIC WAVE EQUATIONS AT ZERO PLANE. Gitman, D. M.; Shakhmatov, V. M.; Shvartsman, Sh. M. (Tomsk Inst. of Automated Systems for Management and Radioelectronics, USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 43-49(1975). (In Russian).

Possible redeterminations of the scalar product for relativistic wave fields of the Klein-Gordon and Dirac type. It is shown that a whole class of new accurate solutions, for which earlier it was not possible to determine the ordinary scalar product on the plane $x^0 = \text{const}$, makes available a correct scalar product on the zero plane $x^0 - x^3 = \text{const}$. The completeness of the set of orthogonal solutions is demonstrated. Possible uses of the results are discussed. (tr-auth)

32024 GROUP-THEORETICAL BASIS FOR THE VALUE OF THE FINE-STRUCTURE CONSTANT. Rosen, G. (Drexel University, Philadelphia, Pennsylvania 19104). Phys. Rev. D 13: No. 4, 830-831 (15 Feb 1976).

If the electromagnetic four-potential is expressed as an invariant superposition of 42 symmetry-related field operators, it is possible to account for the experimental value of the fine-structure constant. Such a theory yields the formula $\hbar c/e^2 = N(N-1)/4\pi = 137.0324$ with $N = 42$ the order of the invariance group. (auth)

32025 SUPERSYMMETRY GENERATORS OF ARBITRARY SPIN. Hietarinta, J. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. D 13: No. 4, 838-850 (15 Feb 1976).

The infinitesimal generators of supersymmetry and translation form a solvable invariant subalgebra of the full graded Lie algebra. In O'Raifeartaigh's classification scheme this belongs to Case (iii). In general we may define the degree-n supersymmetry generators by requiring their nth derived algebra to be equal to translations. In this paper we study degree-1 supersymmetries for which $[S_\alpha, S_\beta] = c\,(\alpha^\mu C)_{\alpha\beta} P_\mu$, where a graded commutator is used. Supposing that $\{S_i\}$ belongs to some representation of the Lorentz group we study the conditions on α^μ and C which result from Jacobi identities and Hermitian conjugation. For the three-dimensional case the conditions are satisfied if $(\alpha^k C)_{ij}$ is chosen to be a Clebsch-Gordan coefficient. This allows S to have any spin $\neq 0$ and also gives the correct spin-statistics connection (grading). In the four-dimensional case we show how the problem is related to that of finding Lagrangian densities $L_k = \bar{\psi}\alpha^\mu \partial_\mu \psi$ and $L_m = \bar{\psi}\psi$, which are Hermitian scalars. There are an infinite number of possible representations to which S_i can belong, including those of Bhabha type, for which the spin-statistics connection comes naturally from the representation. At the same time there can be supersymmetry generators of several different spins. The Volkov-Akulov nonlinear realization works in all cases and a supersymmetry-invariant Lagrangian can be constructed. Anticommutators seem to be important only in the sense that then we can have finite-dimensional linear realizations. (auth)

32026 REDUCTION OF THE STATE VECTOR BY A NONLINEAR SCHRÖDINGER EQUATION. Pearle, P. (Hamilton College, Clinton, New York 13323). Phys. Rev. D 13: No. 4, 857-868 (15 Feb 1976).

It is hypothesized that the state vector describes the physical state of a single system in nature. Then it is necessary that the state vector of a macroscopic apparatus not assume the form of a superposition of macroscopically distinguishable state vectors. To prevent this, it is suggested that a nonlinear term be added to the Schrödinger equation, which rapidly drives the amplitude of one or another of the state vectors in such a superposition to one, and the rest to zero. It is proposed that it is the phase angles of the amplitudes immediately after a measurement which determine which amplitude is driven to one. A diffusion equation is arrived at to describe the reduction of an ensemble of state vectors corresponding to an ensemble of macroscopically identically prepared experiments. Then a nonlinear term to add to the Schrödinger equation is presented, and it is shown that this leads to the diffusion equation in a weak-coupling approximation. (auth)

32027 NEW THEORY OF RADIATIVE ENERGY TRANSFER IN FREE ELECTROMAGNETIC FIELDS. Wolf, E. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 13: No. 4, 869-886 (15 Feb 1976).

A new theory of radiative energy transfer in free, statistically stationary electromagnetic fields is presented. It provides a model for energy transport that is rigorous both within the framework of the stochastic theory of the classical field as well as within the framework of the theory of the quantized field. Unlike the usual phenomenological model of radiative energy transfer that centers around a single scalar quantity (the specific intensity of radiation), our theory brings into evidence the need for characterizing the energy transport by means of two (related) quantities: a scalar and a vector that may be identified, in a well-defined sense, with "angular components" of the average electromagnetic energy density and of the average Poynting vector, respectively. Both of them are defined in terms of invariants of certain new electromagnetic correlation tensors. In the special case when the field is statistically homogeneous, our model reduces to the usual one and our angular component of the average electromagnetic energy density, when multiplied by the vacuum speed of light, then acquires all the properties of the specific intensity of radiation. When the field is not statistically homogeneous our model approximates to the usual phenomenological one, provided that the angular correlations between plane wave modes of the field extend over a sufficiently small solid angle of directions about the direction of propagation of each mode. It is tentatively suggested that, when suitably normalized, our angular component of the average electromagnetic energy density may be interpreted as a quasi-probability (general quantum-mechancial phase-space distribution function, such as Wigner's) for the position and the momentum of a photon. (auth)

32028 SCATTERING STATES AND BOUND STATES AS SOLUTIONS OF THE SCHRÖDINGER EQUATION WITH NONLOCAL BOUNDARY CONDITIONS. Pattanayak, D.N. (Department of Physics, University of Toronto, Toronto M5S 1A7 Canada); Wolf, W. Phys. Rev. D 13: No. 4, 913-923 (15 Feb 1976).

The problem of determining the Schrödinger wave function of a nonrelativistic particle that is either scattered by a potential of a finite range or that is bound to it is reformulated in a novel way. It is shown that in either case the wave function must satisfy a certain boundary condition on the surface that delimits the effective range of the potential. For scattering states the boundary condition is analogous to the mathematical formulation of the Ewald-Oseen extinction theorem of classical electromagnetic theory. The new formulation is illustrated by determining the scattering states and the bound states for a central potential. It is also shown that a boundary condition that is used in band-structure calculations in solids is an immediate consequence of our quantum-mechanical extinction theorem for bound states. (auth)

32029 BHABHA FIRST-ORDER WAVE EQUATIONS. IV. CAUSALITY WITH MINIMAL ELECTROMAGNETIC COUPLING. Krajcik, R.A.; Nieto, M.M. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. D 13: No. 4, 924-941 (15 Feb 1976).

We demonstrate that the arbitrary-spin Bhabha fields with minimal electromagnetic coupling are causal in both the *c*-number and *q*-number theories. We first obtain the Klein-Gordon (KG) divisors in closed form in terms of the elementary symmetric functions. *c*-number causality is easily demonstrated for half-integer spin with the Velo-Zwanziger method and integer spin by using Wightman's suggestion involving the KG divisors. For the *q*-number demonstration we set up an indefinite-metric second-quantized formalism, and use the above KG divisors to show causality in closed form for arbitrary spin. In both the *c*-number and *q*-number theories a special handling of the integer-spin subsidiary components is necessary. Our discussion focuses on the Bhabha indefinite metric and on the connection between the number of derivatives in a theory and the occurrence or nonoccurence of causality. (auth)

32030 A NEW APPROACH TO TIME-DEPENDENT PERTURBATION THEORY. Mehrotra, S.C.; Boggs, J.E. (Department of Chemistry, The University of Texas at Austin, Austin, Texas 78712). J. Chem. Phys. 64: No. 7, 2796-2803 (1 Apr 1976).

A time-dependent perturbation theory for the solution of the time-dependent Schrödinger equation is developed and is applied to systems having two states with pulse and Lorentzian types of perturbations. It is shown in the case of the pulse perturbation that the expression corresponding to the *N*th order of the perturbation theory converges to the exact solution when *N* tends to infinity. The results obtained from this perturbation theory, the Magnus approximation, and the time-dependent perturbation theory developed by Dirac are compared with the exact results. This theory is found to be good for larger values of the perturbations and for larger intervals of time. (auth)

32031 ELECTROMAGNETIC SPIN AND ORBITAL ANGULAR MOMENTA OF A CLASSICAL POINT ELECTRON. López, C.A.; Villarroel, D. (Departamento de Física, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Santiago, Chile). Phys. Rev. D 13: No. 6, 1802-1804 (15 Mar 1976).

The bound momentum and the bound angular momentum of a point particle with arbitrary multipolar electromagnetic moments are considered. It is found that the relation $M^{(b)}{}_{\lambda\mu}(\tau) = 2p_{[\lambda}P^{(b)}{}_{\mu]}(\tau)$, which was established for a nonspinning accelerated point charge, is no longer true in the present case. An additional term emerges, which corresponds to the contribution to the bound angular momentum of the multipolar structure of the particle. (auth)

32032 DRIVEN EQUILIBRIUM METHODS FOR ENHANCEMENT OF NUCLEAR TRANSIENTS. Waldstein, P.; Wallace, W. E. Jr. (Bureau of Mines, Morgantown, WV). Rev. Sci. Instrum.; 42: No. 4, 437-440(Apr 1971).

Several pulsed NMR experiments using rapidly repeating pulse sequences are described. Theoretical results for magnetization as a function of pulse spacing tau are given for cases where the Bloch equations apply, and compared with experiments. These results suggest a simple method of rapid signal accumulation when T_2^* less than T_2, T_1, that is, when resolution is limited by magnet inhomogeneity. (auth)

32033 GENERATION OF GENEALOGICAL SPIN EIGENFUNCTIONS. Grabenstetter, J. E.; Tseng, T. J.; Grein, F. (Univ. of New Brunswick, Fredericton). Int. J. Quant. Chem.; 10: No. 1, 143-149(Jan 1976).

A method is given for generating the Yamanouchi-Kotani genealogical spin eigenfunctions which requires neither storage of eigenfunctions for smaller numbers of electrons, nor summations of large order, nor explicit use of results from the theory of representations of the symmetric group. An explicit formula is given for the coefficients of expansion in terms of spin products. (auth)

32034 THEORY OF QUANTUM TRANSPORT IN A TWO-DIMENSIONAL ELECTRON SYSTEM UNDER MAGNETIC FIELDS, 2. Single-Site Approximation Under Strong Fields. Ando, T. (Tokyo Univ. (Japan). Dept. of Physics). J. Phys. Soc. Jpn.; 36: No. 6, 1521-1529(Jun 1974).

The level broadening and transport properties of a two-dimensional system under extremely strong magnetic fields are investigated in the single-site approximation (SSA). At high concentrations of scatterers, the SSA approaches the simple damping theoretical approximation. At low concentrations, many impurity bands associated with each bound state of an isolated scatterer appear, and the nonexistence of continuous states in this system causes a singular level with zero width in case of scatterers with a δ-potential. The peak value of the conductivity of the impurity band with the angular momentum m is given by $2x_I{}^2N_i(N + m + \frac{1}{2})e^2/x^2h$, where N is the Landau quantum number and N_i is the concentration of scatterers. The density of states and the conductivity are calculated explicitly for a model system which contains scatterers with the Gaussian potential. (auth)

Quantum Field Theories

Refer also to abstracts 31358, 31360, 31364, 31414, 31504, 31575, 31579, 31593, 31602, 31614, 32115, 32120, and 32125.

32035 (INIS-mf-1983) THE INFINITE MOMENTUM FRAME METHOD IN FIELD THEORY WITH SOME APPLICATIONS. van Neerven, W. L. G. A. M. (Katholieke Universiteit Nijmegen (Netherlands). Afdeling Theoretische Natuurkunde). 1975. 216p. INIS.

An outline is given of the infinite momentum frame (I.M.F.) method in renormalizable field theories, which is based on time ordered perturbation theory. The method is applied to calculate radiative corrections to the anomalous magnetic moment of the electron and the muon. An introduction is given to the parton

model, which is then applied to deep inelastic electroproduction e + p → e + anything. From experiments on this reaction it is found that the structure functions to scale. The parton model is also applied to massive muon pair production p + p → $\mu^+\mu^-$ + anything, and in this case the infinite momentum itself appears as a scaling variable. I.M.F. techniques are used to calculate the anomalous thresholds which appear in the amplitudes of hadron-hadron scattering. (PJS)

32036 METASTABILITY EXCHANGE IN A MIXTURE OF HELIUM ISOTOPES AT LIQUID NITROGEN TEMPERATURE. Zhitnikov, R.A.; Kartoshkin, V.A.; Klement'ev, G.V.; Usacheva, L.V. (A. P. Ioffe Physico-technical Institute, USSR Academy of Sciences). JETP Lett. 22: No. 5, 136-137 (5 Sept 1975).

We investigated the optical orientation and the magnetic resonance of He^3 and He^4 atoms in 2 $^3S_1$ states in He^3-He^4 isotope mixtures. We measured the metastability exchange cross sections σ (He^3-He^3) and σ (He^3-He^4) at liquid-nitrogen temperature. An appreciable difference between these cross sections was observed. (auth)

32037 FIELDS AND OBSERVABLE ALGEBRAS IN MODELS WITH THE SUPERSELECTION RULES. II. Model with the Non-Abelian Gauge Group. Khoruzhii, S. S. (Mathematics Inst., Moscow). Teor. Mat. Fiz.; 26: No. 1, 3-15(Jan 1976). (In Russian).

The relation between fields and observables in simple algebraic models, in which the observables and the set of superselection rules are defined by gauge groups, is studied. One considers the fermion model with the non-abelian group U(1). Using the twisting operation for the fermion field algebras one proves the duality in abelian coherent superselection sectors as well as in the irreducible subspaces of the nonabelian coherent sectors. Extended intertwining operators are constructed which belong to the field algebras and realize the asymptotic unitary equivalence of coherent sectors. Normal commutation relations for these operators are established. Then, using the Klein transformation, one constructs the extended intertwining of the other kind, which are parafermion fields of the second order. (auth)

32038 SPONTANEOUS BREAKING OF THE SYMMETRY OF THE FIRST KIND. Vigman, P. B.; Larkin, A. I.; Felev, V. M. (Inst. of Theoretical Physics, Moscow). Yad. Fiz.; 22: No. 6, 1255-1264(Dec 1975). (In Russian).

A spontaneous symmetry breaking similar to the phase transition of the first kind is considered. Such symmetry breaking takes place in many double-charged models of scalar particles interacting one with another or with Yang–Mills fields. In these models one of the four-boson interaction constants can be negative at small momenta. The arising instability leads to the condensate production. The possibility of spontaneous breaking of the symmetry of the first or second kind (Higg's mechanism) is studied as a function of relations between interaction constants in the ultraviolet region. (auth)

32039 FINAL STATE RADIATION EFFECTS IN QUANTUM ELECTRODYNAMICS. Dente, G. C. Seattle; Univ. of Washington (1975). 67p. University Microfilms Order No. 76-4749.

Thesis (Ph. D.).

This paper establishes the classical causal limit for current-current interactions in Q. E. D., thereby solving a problem which has persisted for over forty years. Once final state radiation effects are allowed for in a non-perturbative manner, it is shown that Q. E. D. describes particles interacting via retarded Lienard-Wiechert potentials; these results are obtained by using Fermi's formulation of the transverse field as a set of quantized oscillators coupled to particle currents, and then by applying functional integration methods to eliminate the intermediate photon coordinates subject to conditions of initial photon vacuum and final photon radiation fields. The first half of the paper shows that specification of initial vacuum and final radiation states holds direct consequences for effective particle interactions. Juxtaposed to these conclusions are the Lamb Shifts and anomalous moment calculations, which are in agreement with experiment; these calculations are conventionally completed without considering final state radiation. If specification of final radiation is to affect these radiative correction calculations, then the final numbers to be compared with experiment must not be greatly changed. These considerations comprise the latter half of the work, in which the effects of final state radiation on predicted radiative corrections are demonstrated. Finally, the second half of the paper raises, and to an extent answers, questions related to the problem of building potentials from the exchange of intermediate quanta. Whereas most of the paper deals with Q. E. D., in which the exchanged quanta are photons, the findings of this last section are applicable to all coupled quantum field theories. (Diss. Abstr. Int., B)

32040 GENERATING S MATRIX FUNCTIONAL IN THE THEORY OF GAUGE FIELDS. II. Massless Yang–Mills Field. Vasil'ev, A. N.; Pis'mak, Yu. M. Vestn. Leningr. Univ., Fiz., Khim.; No. 3, 7-12(Aug 1975). (In Russian).

The transversality and gauge independence of the renormalized S matrix of the massless Yang–Mills field are proved (on the mass shell for gauges nB + C = 0). (auth)

32041 DIAGRAMS IN GENERAL PERTURBATION THEORY FOR A NEAR DEGENERATE STATE. Lyaptsev, A. V.; Kiselev, A. A. Vestn. Leningr. Univ., Fiz., Khim.; No. 3, 28-36(Aug 1975). (In Russian).

The series of general perturbation theory are studied for the case when there is an eigenvalue which nearly coincides with those of interest. Using diagrams the terms containing small energy differences in denominators are summed over all the orders. Special diagrams are shown to exist which take into account this summing. (auth)

32042 PROPERTIES OF MASSLESS RELATIVISTIC FIELDS UNDER THE CONFORMAL GROUP. Post, G. (Institut fuer Theoretische Physik, Aachen). J. Math. Phys. (N.Y.); 17: No. 1, 24-32(Jan 1976).

Using the ladder representations of SU(2,2), explicit transformation laws are derived for massless free fields with arbitrary helicities under global conformal transformations. (auth)

32043 THEOREM ON STRESS-ENERGY TENSORS. Lord, E. A. (Indian Inst. of Science, Bangalore). J. Math. Phys. (N.Y.); 17: No. 1, 37-38(Jan 1976).

The equality of the symmetrized Noether stress–energy tensor (Belinfante's tensor) and the canonical stress–energy tensor (functional derivative of the Lagrangian density with respect to the metric) is established by methods based on the formalism of tetrads and Ricci rotation coefficients. The result holds for any Lagrangian which contains no derivatives of the fields higher than first order. (auth)

32044 UPPER BOUND ON THE ENERGY GAP IN THE (lambda phi^4 + sigma $phi^2)_2$ MODEL. Klein, A. (Univ. of California, Irvine); Landau, L. J. J. Math. Phys. (N.Y.); 17: No. 1, 87-93(Jan 1976).

Let DELTA E(lambda,sigma,m_0) be the energy gap in the infinite volume quantum field theory with bare mass m_0 and interaction lambda phi^4 + sigma phi^2 in two space–time dimensions, obtained with either full-Dirichlet or half-Dirichlet boundary conditions. Then DELTA E(lambda,sigma,m_0)/m_0 less than exp[sigma/(m_0^2 + 3 lambda/II)] for all lambda greater than 0 and sigma real. In particular DELTA E(lambda,0,m_0) less than m_0 for all lambda greater than 0 and DELTA E(lambda,sigma, m_0)/m_0 yields 0 as sigma yields – infinity. For half-Dirichlet boundary conditions one also has DELTA E(lambda,sigma,m_0)/ m_0 less than (1 + 2 sigma/m_0^2)/sup ½/ for sigma greater than or equal to 0,lambda greater than 0. In each pure phase of a (lambda $phi^4)_2$ theory, let m/sub phys/ be the energy gap and [phi] the expectation of the field. Then m/sub phys//m_0 less than exp[2II(phi)^2/(1 + II m_0^2/3 lambda)]. (auth)

32045 STATISTICAL APPROACH AND DUALITY. Jenkovszky, L. L. (Inst. for Theoretical Physics, Kiev); Trushevskii, A. A.; Sertorio, L. Lett. Nuovo Cim.; 15: No. 6, 200-202 (7 Feb 1976).

Statistical consequences in a previous approach resulting from the saturation by narrow resonances and by Regge asymptotic behavior are compared. Strong duality suggests agreement between those results. It is shown that this is not the case. The result of the calculation shows that the density of resonances in the elastic amplitude decreases with energy. (JFP)

32046 CANONICAL QUANTIZATION ON GENERAL SPACE-LIKE HYPERSURFACES. Kramer, D. (Univ., Jena, Ger.). Acta Phys. Pol., Ser. B; B7: No. 2, 117-125(Feb 1976).

A Schroedinger type quantization of free fields on arbitrary spacelike hypersurfaces in curved space-time is considered. The gravitational field is assumed to be a classical background. In the field representation the state functional depends on the field configuration on the hypersurface. A generalized Tomonaga–Schwinger equation describes the dynamical evolution of the quantum field. The expectation values of the field operators (e.g., energy-momentum tensor) are defined. (auth)

32047 A GENERALIZATION OF THE CLASSICAL MOMENT PROBLEM ON *-ALGEBRAS WITH APPLICATIONS TO RELATIVISTIC QUANTUM THEORY. Pt. 1. Dubois-Violette, M. (Paris-11 Univ., 91- Orsay (France). Lab. De Physique Theorique et Hautes Energies). Commun. Math. Phys.; 43: No. 3, 225-254 (1975).

24 refs.

A (non-commutative) generalization of the classical moment problem is formulated on arbitrary *-algebras with units. This is used to produce a C*-algebra associated with the space of test functions for quantum fields. This C*-algebra plays a role in theories of bounded localized observables in Hilbert space which is similar to that of the space of test functions in quantum field theories (namely it is represented in Hilbert space). The case of local quantum fields which satisfy a slight generalization of the growth condition is investigated. (DE)

32048 RENORMALIZATION GROUP EQUATIONS WITH MULTIPLE COUPLING CONSTANTS. Ghika, G.; Visinescu, M. (Inst. for Atomic Physics, Bucharest). Nuovo Cim., A; 31A: No. 2, 294-304(21 Jan 1976).

The renormalization group equations of a renormalizable field theory are studied with multiple coupling constants. A method for the investigation of the asymptotic stability is presented. This method is applied to a gauge theory with Yukawa and self-quartic couplings of scalar mesons in order to find the domains of asymptotic freedom. An asymptotic expansion for the solutions which tend to the origin of the coupling constants is given. (auth)

32049 QUANTUM ELECTRODYNAMICS IN ELECTRON–POSITRON SYSTEMS. Hofstadter, R. (Stanford Univ., CA). pp 869-911 of Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies. Kirk, W. T. (Ed.). Stanford, CA; Stanford Univ. (1975).

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975). See CONF-750855-.

A short review of the current status of quantum electrodynamics (QED) is presented, in addition to background material on this subject, new material first presented at this SLAC symposium is summarized. All three experimental processes e^+e^- yields e^+e^-, e^+e^- yields $mu^+ mu^-$, e^+e^- yields gamma gamma are examined and are shown to be in accord with the predictions of QED. The first two processes are given correctly by QED even up to center-of-mass energies of 7.1 and 7.4 GeV respectively. The available results in the third process are restricted to 5.2 GeV. Radiative corrections are applied and allow appropriate quantitative limits of validity of QED to be expressed in several parametric forms. Polarization effects in e^+e^- collisions are described, and experiments on the Lyman-alpha transition in positronium are discussed. (auth)

32050 THEORY OF FERMION EXCHANGE IN MASSIVE QUANTUM ELECTRODYNAMICS AT HIGH ENERGY. I. McCoy, B.M. (The Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794); Wu, T.T. Phys. Rev. D 13: No. 2, 369-378 (15 Jan 1976).

We consider the high-energy behavior of Compton scattering near the backward direction and of pair annihilation into two photons in massive quantum electrodynamics. We study the limit where s, the center-of-mass energy squared, becomes large and t, the square of the momentum transfer, is fixed and spacelike. In each order of perturbation theory we calculate the leading terms in the $s \to \infty$ expansion, and then these leading terms are summed. In the positive-signature channel this leads to a Regge pole. In the negative-signature channel the amplitude is dominated by a pole when $-t$ is sufficiently small. However, as $-t$ increases the pole moves to the left and eventually the amplitude is dominated by the fixed Mandelstam cut. In this paper we present the results of our calculations, summarize the most important features of the calculations, and discuss the physics of the result. The details of the calculations are presented in the 5 succeeding papers. (auth)

32051 THEORY OF FERMION EXCHANGE IN MASSIVE QUANTUM ELECTODYNAMICS AT HIGH ENERGY. II. SIXTH-ORDER PERTURBATION THEORY. McCoy, B.M. (The Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794); Wu, T.T. Phys. Rev. D 13: No. 2, 379-394 (15 Jan 1976).

In this paper we present the details of our sixth-order perturbation theory calculation of the high-energy behavior of Compton scattering near the backward direction and pair annihilation. For each of these matrix elements, a formula is obtained not only for the leading term, which is real, but also for the leading imaginary part. Momentum-space techniques are used throughout. In particular we impose a cutoff in the transverse momentum and then compute the behavior as s (the square of the center-of-mass energy) $\to \infty$. With this procedure there are 3 Feynman diagrams which contibute to the leading real part. These 3 diagrams each give a factor of $\ln^2 s$ and an integral over transverse-momentum space. Each of these 3 transverse integrals separately diverge as $k_{max} \to \infty$ but when added together the $k_{max} \to \infty$ limit may be taken and the result agrees with the result previously obtained by Feynman parameters. To complete the evaluation of the leading imaginary part a fourth diagram is needed. (auth)

32052 THEORY OF FERMION EXCHANGE IN MASSIVE QUANTUM ELECTRODYNAMICS AT HIGH ENERGY. III. EIGHTH-ORDER PERTURBATION THEORY. McCoy, B.M. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794); Wu, T.T. Phys. Rev. D 13: No. 2, 395-423 (15 Jan 1976).

We extend the detailed calculations of the preceding paper to eighth order. We find 7 diagrams are needed to evaluate the leading real part and an additional 5 are needed for the complete evaluation of the leading imaginary part. (auth)

32053 THEORY OF FERMION EXCHANGE IN MASSIVE QUANTUM ELECTRODYNAMICS AT HIGH ENERGY. IV. TENTH-ORDER PERTURBATION THEORY. McCoy, B.M. (The Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794); Wu, T.T. Phys. Rev. D 13: No. 2, 424-483 (15 Jan 1976).

The detailed calculations of the preceding two papers are continued to tenth order. There are 41 Feynman diagrams which must be considered. These diagrams fall into 3 categories: (1) fifteen which contribute to the leading real part, (2) six which individually contribute to the leading imaginary part that cancel in pairs in the sum, and (3) twenty which contribute to the leading imaginary part which do not cancel identically in the sum. (auth)

32054 THEORY OF FERMION EXCHANGE IN MASSIVE QUANTUM ELECTRODYNAMICS AT HIGH ENERGY. V. TWELFTH- AND HIGHER-ORDER PERTURBATION THEORY. McCoy, B.M. (The Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794); Wu, T.T. Phys. Rev. D 13: No. 2, 484-507 (15 Jan 1976).

We extend to twelfth order our study of the high-energy behavior of Compton scattering near the backward direction and of pair annihilation in massive quantum electrodynamics. We then generalize our considerations by introducing a matrix method of calculating higher-order diagrams and present the result of the high-energy expansion of an arbitrarily high order of perturbation theory. (auth)

32055 EQUIVALENT-BOSON METHOD AND FREE CURRENTS IN TWO-DIMENSIONAL GAUGE THEORIES. Halpern, M.B. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. D 13: No. 2, 337-342 (15 Jan 1976).

In the context of the equivalent-boson method a large variety of quark-gluon theories are studied in two dimensions. A number of simple results are obtained, including the fact that fluon interactions (Abelian and non-Abelian) leave most of the physical currents free (at zero quark mass). (auth)

32056 ASYMPTOTIC BEHAVIOR OF THE ELASTIC FORM FACTOR IN TWO-DIMENSIONAL SCALAR FIELD THEORY OF THE BAG MODEL. Krapchev, V. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 13: No. 2, 329-336 (15 Jan 1976).

In the framework of the two-dimensional scalar quantum theory of the bag model of Chodos *et al.* a definition of the physical field and a general scheme for constructing a physical state are given. We expose some of the difficulties associated with such an approach. Expressions for the physical current and the elastic form factor are given. The calculation of the latter is restricted at first to the approximation in which the mapping from a bag of changing shape to a fixed domain is realized only by a term which is a diagonal, bilinear function of the creation and annihilation operators. This is done for the case of a one-mode and an infinite-mode bag theory. By computing the form factor in an exact one-mode bag model we show that the logarithmic falloff of the asymptotic term is the same as the one in the approximation. On the basis of this a form for the asymptotic behavior of the form factor is suggested which may be correct for the general two-dimensional scalar bag theory. (auth)

32057 IS MASSLESS QUANTUM ELECTRODYNAMICS A FREE-FIELD THEORY? Eilam, G.; Glück, M. (Institut für Physik, Universität Mainz, 6500 Mainz, West Germany). Phys. Rev. D 13: No. 2, 279-281 (15 Jan 1976).

We show that if the photon wave-function renormalization constant is finite, then in the limit of zero fermion mass quantum electrodynamics is a free-field theory. (auth)

32058 LARGE-N BEHAVIOR FOR INDEPENDENT-VALUE MODELS. Klauder, J.R.; Narnhofer, H. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. D 13: No. 2, 257-266 (15 Jan 1976).

Highly specialized, N-component, scalar model quantum field theories invariant under O(N) transformations are studied in the limit of large N. The models are expressed in n-dimensional Euclidean space-time and differ from conventional covariant quantum models by the absence of all space-time gradients, a modification that leads to nonrenormalizable

$O(N)$ -invariant interactions for each $N \geq 1$. These models are solved by nonperturbative techniques, and the solutions exhibit two striking and unfamiliar properties: (1) For finite (or infinite) N, the solutions of any interacting theory do not reduce to those of the free theory in the limit where the coupling of the nonlinear interaction vanishes; and (2) the relevant (asymptotic) dependence of the parameters of the interacting theories on N differs from the conventional choice, and the limit $N \rightarrow \infty$ does not lead to a Hartree-type solution. It is proposed that similar unconventional behavior may characterize certain $O(N)$ -invariant, covariant nonrenormalizable quantum field theories, and in particular that the limit $N \rightarrow \infty$ may not lead to a Hartree (or Hartree-Fock) type of solution. (auth)

32059 ACTION PRINCIPLE FOR SPIN-1/2 WAVE EQUATIONS. Ahner, H.F. (Adelphi University, Garden City, New York 11530). Phys. Rev. D 13: No. 2, 250-256 (15 Jan 1976).

An action principle is presented whose variation yields *both* Dirac's spin-1/2 equation and Staunton's positive-energy spin-1/2 equation. The Lagrangian used is a function not only of the matter, electromagnetic, and gravitational fields, but also of the structure constants of the internal group. Variation with respect to the matter field gives the dynamical equations of motion. Variation with respect to the electromagnetic and gravitational fields yields Maxwell's and Einstein's equations, respectively. These equations include source terms that are the electromagnetic current and the stress-energy tensors for the matter and electromagnetic fields. Variation with respect to the structure constants determines the internal group, thereby projecting out either Dirac's or Staunton's equation. The matter stress-energy tensor herein determined is used to construct the energy operator for the second-quantized free fields. The results obtained in the case of Dirac's equation are the standard ones. In the case of Staunton's equation, the matter stress-energy tensor and energy operator are found for the first time. (auth)

32060 SCALAR EFFECTIVE LAGRANGIAN IN DE SITTER SPACE. Dowker, J.S.; Critchley, R. (Department of Theoretical Physics, The University, Manchester, England). Phys. Rev. D 13: No. 2, 224-234 (15 Jan 1976).

Scalar field theory is considered in a de Sitter-space background and the effective Lagrangian calculated exactly using the proper-time regularization technique. The imaginary part vanishes and this result is shown to hold for all spins on quite general grounds. (auth)

32061 PRESCRIBED SOURCES AND GAUGE CONDITIONS. Boulware, D. G. (Univ. of Washington, Seattle); Deser, S. Nuovo Cim.; 31A: No. 3, 498-504(1 Feb 1975).

Arbitrary, nonconserved, external sources may be coupled to gauge fields. The conservation identities on the field equations then become gauge-fixing conditions on the gauge-breaking terms needed to implement this approach. The stability of coordinate choices under source variations is discussed in the Einstein case. (auth)

32062 CLASSICAL ELECTRODYNAMICS WITH EXTENDED CHARGES. Richoz, A. (Univ., Zurich). Helv. Phys. Acta; 49: No. 1, 99-121(1976).

The problem of the existence, uniqueness, smoothness of the solution of the coupled Maxwell–Newton equations is investigated for a charge distribution with compact support. A detailed study of this problem for the case of a spherical shell distribution shows that the limit of Lorentz-Dirac is not physical. (auth)

32063 ANALYTICITY PROPERTIES AND MANY-PARTICLE STRUCTURE IN GENERAL QUANTUM FIELD THEORY. Pt. 2. One-Particle Irreducible N-Point Functions. Bros, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service de Physique Theorique); Lassalle, M. (Ecole Polytechnique, 75- Paris (France). Centre de Physique Theorique). Commun. Math. Phys.; 43: No. 3, 279-309(1975).

The extraction of one-particle singularities from the n-point functions is performed in the framework of L.S.Z. field theory in the case of a single massive scalar field. It is proved that the "one-particle irreducible" functions thus obtained enjoy the analytic and algebraic primitive structure of general n-point functions (up to a finite number of generalized C, D, D. singularities). Finally under an additional technical assumption, it is shown that the Glaser–Lehmann–Zimmermann relations stating the completeness of asymptotic states yield similar relations satisfied in any given channel by the corresponding one-particle irreducible functions. (DE)

32064 SELF-ENERGY DIVERGENCE LOOPS IN SPINOR FIELDS. Panday, R. C. (Allahabad Univ. (India). Dept. of Physics). Proc. Indian Natl. Sci. Acad., Part A; 40: No. 5, 279-285(Sep 1974).

In freely propagating spinor fields, divergence loops are considered to occur, and a renormalization is shown to change the mass of the particle into a matrix of integrals. The canonical form for dilation current is obtained without improvements on the stress tensor. This is seen necessary for divergence loops to occur and the improvement terms of Callan-Coleman-Jackiew (1970) are seen to vanish in a generalized formulation of improved Belinfante stress tensor. It is shown that one-loop divergences are not equivalent to gauge transformation of fields, but are cancelled by altering the mass of the field. (auth)

32065 A UNIFIED APPROACH TO MEAN FIELD ELECTRODYNAMICS. Roberts, P. H.; Soward, A. M. (Newcastle upon Tyne Univ. (UK)). Astron. Nachr.; 296: No. 2, 49-64(1975).

Using the first order smoothing approximation and a novel technique (double Fourier transformation and expansion) a number of results, new and old, in the theory of mean field electrodynamics and magnetohydrodynamics are given as a systematic and general derivation. They are cast into forms which brings into new prominence the role of the helicity spectrum in the induction process. The situations in which the results may be expected to be accurate are delineated. New expressions are given for the reduction in the mean electromotive force created by the Lorentz forces acting on the microscale turbulence. (GC)

32066 LAGRANGIAN FORMALISM FOR FINITE COMPONENT FIELDS WITHOUT SUBSIDIARY CONDITIONS. Zajkov, R. P. Bulg. J. Phys.; 1: No. 3, 249-262(1974). (In Russian).

A Lagrangian formalism for tensor and spinor fields, which ensures the spectral conditions without subsidiary conditions is considered. Constructing the theory of spinor and tensor fields it turns out not to be necessary to exclude the lower spins. In order to obtain fields with a definite spin certain projection operators are used. Such an approach gives a free theory which is local, and a canonical formalism. Interaction with the electromagnetic field is considered. The propagators of the tensor and spinor fields are obtained.

32067 ELIMINATION OF THE $P^+ = 0$ MODE IN THE LIGHT-LIKE QUANTIZATION OF FIELDS. Ida, M. (Kyoto Univ.). Lett. Nuovo Cim.; 15: No. 8, 249-253(21 Feb 1976).

The usual procedure of simply neglecting the $P^+ = 0$ mode in the quantization of relativistic field theory is justified by the Dirac theory. The present method avoids an artificial restriction to x^- by introducing a function called $\eta(x)$. The simplest example of a neutral scalar field interacting with itself by $\lambda\phi^4$ is considered. (JFP)

32068 METRIC TENSORS, LAGRANGIAN FORMALISM AND ABELIAN GAUGE FIELD ON THE POINCARE GROUP. Arodz, H. (Jagellonian Univ., Krakow). Acta Phys. Pol., Ser. B7: No. 3, 177-190(Mar 1976).

All metrics on the Poincaré group which are form invariant under transformations of the relativistic symmetry as well as spatial rotations of a basis attached to the particle are found. The lagrangian formalism for classical fields on P is developed and applied to the abelian gauge field. It is shown that in a particular choice of metric the gauge field has a neutral, massive and Γ^- component in addition to the usual electromagnetic field.

32069 QUANTIZED SOLITARY WAVES IN NONLINEAR MESON FIELDS AND THEIR APPLICATION TO NUCLEON–NUCLEON AND NUCLEON–ANTINUCLEON INTERACTIONS. Sebhatu, M. Clemson, SC; Clemson Univ. (1975). 73p. University Microfilms Order No. 76-4211.

Thesis (Ph.D.).

A quantized solitary wave theory specified by a nonlinear field equation is reviewed and applied to nucleon-nucleon and nucleon-antinucleon interactions. Exact particular solutions (solitary wave solutions) for the nonlinear field equation are obtained by direct integration. The solitary wave solutions describe massive, persistently self-interacting, spin-zero systems. They only reduce to linear free fields in the limit of vanishing self-interaction coupling constants. This permits the quantization of the solitary wave solutions by recognizing that they contain the creation or annihilation (A/sub k//sup (+-)/) operators of the linear field theory which satisfy the usual commutation relation [A/sub k//sup (+-)/, A/sub k'/] equals delta/sub kk'/. The quantized solitary waves are employed in the construction of a solitary wave propagator by using the superposition principle of a quantum theory for conditional probability amplitudes. The resulting propagator exhibits poles at regular mass intervals [m/sub n/ equals (2n + 1)m] (m equals mass of associated linear free fields) with residues that depend on self-interaction coupling constants. The existence of the poles is characteristic of the presence of a sequence of single particle states. This indicates that the quantized solitary wave theory is a multi-particle theory. It also leads to a mass formula that reasonably works for neutral pseudoscalar mesons. Application of the solitary wave propagator in the usual covariant perturbation theory derivation of a two-nucleon potential yields a solitary wave exchange potential (SWEP) that approaches the one-pion-exchange

potential tail at large (mr much greater than 1) ranges, is attractive especially at intermediate ranges (0.6 less than or equal to mr less than or equal to 1) ranges, and smoothly becomes repulsive at very short (mr less than or equal to 0.6) ranges. The solitary wave propagator is further used in second-order, elastic, nucleon-antinucleon scattering cross-section calculation. It results in a damped, oscillatory cross-section that is superimposed in an envelope that falls off with energy. (Diss. Abstr. Int., B)

32070 GAUGE FIELDS ON SUPERSPACES WITH DIFFERENT HOLONOMY GROUPS. Akulov, V.P.; Volkov, D.V.; Soroka, V.A. (Physico-technical Institute, Ukrainian Academy of Sciences). JETP Lett. 22: No. 7, 187-188 (5 Oct 1975).

We discuss variants of a generally-covariant theory of superfields with nonzero values of the torsion tensors and the curvature tensor. (auth)

32071 FUNDAMENTAL PROBLEMS OF THE ELECTRODYNAMICS OF ELECTRONS INTERACTING WITH QUANTIZED PLANE-WAVE FIELDS. II. Bagrov, V. G.; Gitman, D. M.; Kuchin, V. A.; Lavrov, P. M. (Tomsk State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 11-15(1975). (In Russian).

Some unsolved basic problems of the known model electron + second-quantized plane wave are clarified. The approximation is found which is necessary in order to arrive at the model examined from the precise quantum electrodynamics. Some mathematical and physical singularities of the problem are studied. (tr-auth)

32072 SPONTANEOUS SYMMETRY BREAKING. POSSIBLE VALUES OF THE SPIN OF A GOLDSTONE PARTICLE. Konopel'chenko, B.G. (Nuclear Physics Institute, Siberian Division, USSR Academy of Sciences). JETP Lett. 22: No. 8, 204-205 (20 Oct 1975).

The possibility of spontaneous breaking of continuous symmetry and the admissible values of the Goldstone-particle spins are considered for space-time of arbitrary dimension at zero and finite temperature. (auth)

32073 NEW EXACT SOLUTION OF THE DIRAC EQUATION IV. Bagrov, V. G.; Gitman, D. M.; Meshkov, A. G.; Simanchuk, V. I. Fedosov, N. I.; Shapovalov, A. V.; Shapovalov, V. N. (Tomsk State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 8, 73-79(1975). (In Russian).

New exact solutions of the Dirac equation are considered. Solutions of equations are found for four cases of crossed fields, which are a combination of the field of a plane, linearly polarized wave, and a certain field which in a complex fashion depends on y and $x_0 - z$. (tr-auth)

32074 INFRARED FINITENESS IN YANG-MILLS THEORIES. Appelquist, T. (Department of Physics, Yale University, New Haven, Connecticut 06520); Carazzone, J.; Kluberg-Stern, H.; Roth, M. Phys. Rev. Lett. 36: No. 14, 768-772 (5 Apr 1976).

The infrared divergences of renormalizable theories with coupled massless fields (in particular the Yang-Mills theory) are shown to cancel for transition probabilities corresponding to finite-energy-resolution detectors, just as in quantum electrodynamics. This result is established through lowest nontrivial order in perturbation theory for the detection of massive muons in a quantum electrodynamic theory containing massless electrons or the detection of massive quarks in a Yang-Mills theory. (auth)

32075 TACHYONS, BROKEN LORENTZ INVARIANCE, AND A PENETRABLE LIGHT BARRIER. Everett, A.E. (Department of Physics, Tufts University, Medford, Massachusetts). Phys. Rev. D 13: No. 4, 785-794 (15 Feb 1976).

We present a class of theories differing from special relativity in the existence of a preferred reference frame and deviations from the Lorentz transformations. The theories can be made to agree with existing experiments, but predict, for v close enough to c, departures from the special-relativistic dependence of masses and lifetimes on velocity, and allow the possibility, at least in principle, of accelerating ordinary particles to speeds greater than c. (auth)

32076 TACHYON BEHAVIOR IN THEORIES WITH BROKEN LORENTZ INVARIANCE. Everett, A.E. (Department of Physics, Tufts University, Medford, Massachusetts). Phys. Rev. D 13: No. 4, 795-805 (15 Feb 1976).

We consider questions relating to the production and detection of tachyons obeying one of the models of a non-Lorentz-invariant theory of tachyons developed in the preceding paper. We find one of these models to be promising, in that the existence of tachyons described by the model does not appear to contradict existing experiments, while it appears that the detection of such tachyons experimentally may be possible. The other models lead either to conflicts with experiment or to the implication that the existence of tachyons would be very difficult to observe. (auth)

32077 INTEGRAL EQUATIONS FOR EXTENDED SOLUTIONS IN FIELD THEORY: MONOPOLES AND DYONS. Bais, F.A.; Primack, J.R. (Physics Department, University of California, Santa Cruz, California 95064). Phys. Rev. D 13: No. 4, 819-829 (15 Feb 1976).

In this paper we give a simple method to obtain extended solutions of nonlinear classical field theories. The technique applies to problems where the boundary values at either end of the domain are specified, and consists of converting the set of field equations to a system of coupled nonlinear integral equations that can be solved numerically by simple iteration. As an illustration, the 't Hooft monopole and the Julia-Zee dually charged monopole system are studied in detail. The physical structure of these extended solutions and the possible effects of quantum fluctuations are briefly discussed. (auth)

32078 RENORMALIZABLE INTERACTIONS WITH ONLY ONE COUPLING CONSTANT. Levin, D.N. (Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637). Phys. Rev. D 13: No. 4, 832-837 (15 Feb 1976).

A search is begun for renormalizable Lagrangians in which the bare interaction vertices of several different fields are all related to the value of a single coupling constant. Such models have great predictive power. A study is made of the five ϕ^4-type interactions of two real scalar fields. We search for renormalizable ways of imposing four relations on the five bare coupling constants. Specifically, we look for all renormalizable models in which the five bare coupling constants lie on a line in coupling-constant space, which is linearly, quadratically, or cubically parameterized by a single coupling constant. It is shown that the only theories of this type either have decoupled ϕ_1, ϕ_2 interactions or have the O(2) -invariant form, which is known to be renormalizable. Therefore, in this example all renormalizable interactions with a single coupling constant are symmetric under a group of field transformations; no "new" renormalizable Lagrangians are found. (auth)

32079 UNIQUENESS OF RENORMALIZED QUANTITIES IN DIMENSIONAL REGULARIZATION. Kang, J.S. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 13: No. 4, 851-856 (15 Feb 1976).

It is proved that in any order of perturbation expansion the dimensionally regularized Feynman integration may be multiplied by an arbitrary analytic function of the space-time dimension, which can be absorbed in the redefinition of the bare coupling constants so that the finite renormalized quantities are unchanged. It is also shown that the Ward-Takahashi identities of a gauge theory are unaffected by this multiplication factor. A most convenient choice of the multiplicative analytic function is suggested and the effective potential of massless $\lambda\phi^4$ theory is calculated in the two-loop approximation as an explicit example. (auth)

32080 DYNAMICAL DERIVATION OF VACUUM OPERATOR-PRODUCT EXPANSION IN EUCLIDEAN CONFORMAL QUANTUM FIELD THEORY. Dobrev, V.K. (Joseph Henry Laboratories of Physics, Princeton University, New Jersey 08540); Petkova, V.B.; Petrova, S.G.; Todorov, I.T. Phys. Rev. D 13: No. 4, 887-912 (15 Feb 1976).

An expansion of the type $\langle\phi(x_1)\ldots\phi(x_n)\rangle_0 = \langle\phi(x_1)\phi(x_2)\rangle_0 \langle\phi(x_3)\ldots\phi(x_n)\rangle_0 + \Sigma_{\chi_l} C^2(\chi_l) \int (dp)\, Q^{\chi_l}(x_1, x_2; -p) w_{\chi_l}(p) Q^{\chi_l}(p; x_3, \ldots x_n)$ is derived, where $\chi_l = [l, c_l]$ are labels for infinite-dimensional symmetric tensor representations of the Euclidean conformal group $O\uparrow(2h+1, 1)$, $X_1 = [1, -c_l]$, the constants $C(\chi_l)$ are real, and Q^χ and w_χ have the properties of vacuum expectation values of field products. The starting point is an infinite set of coupled nonlinear integral equations for Euclidean Green's functions in $2h$ space-time dimensions of the type written some 15 years ago by Fradkin and Symanzik. The Green's functions of the corresponding Gell-Mann–Low limit theory are expanded in conformal partial waves. The dynamical equations imply the existence of poles and factorization of residues in the partial waves as functions of the representation parameters. In proving the validity of the expansion we use some differential relations between partially equivalent exceptional representations $O\uparrow(2h+1, 1)$, established in an earlier paper. This work completes the group-theoretical derivation of the vacuum operator-product expansion undertaken by Mack in 1973. (auth)

32081 LARGE-PHOTON-NUMBER LIMIT AND THE ESSENTIAL SINGULARITY IN FINITE QUANTUM ELECTRODYNAMICS. Eilam, G. (Institut für Physik, Universität Mainz, 6500 Mainz, West Germany). Phys. Rev. D 13: No. 4, 942-946 (15 Feb 1976).

It is shown that the essential singularity in finite quantum electrodynamics can be located by considering only those diagrams with a large number of photons exchanged in the single-fermion loop, without photons emitted and absorbed on a fermion line. (auth)

32082 COMMENTS ON QUANTUM THEORY WITH SHADOW STATES. Stapp, H.P. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 13: No. 4, 947-949 (15 Feb 1976).

It is shown that in shadow-state theories the particle mediating a one-shadow–particle-exchange process is propagated via a principal-value propagator. This leads to striking noncausal effects that in principle are observable. It is also noted that the pole-factorization and cluster properties hold in shadow-state theories. (auth)

32083 RELATIVISTIC QUANTUM TRANSPORT THEORY APPROACH TO MULTIPARTICLE PRODUCTION. Carruthers, P. (Theoretical Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544); Zachariasen, F. Phys. Rev. D 13: No. 4, 950-960 (15 Feb 1976).

The field-theoretic description of multiparticle production processes is cast in a form analogous to ordinary transport theory. Inclusive differential cross sections are shown to be given by integrals of covariant phase-space distributions. The single-particle distribution function $F(p, R)$ is defined as the Fourier transform of a suitable correlation function in analogy with the nonrelativistic (Wigner) phase-space distribution function. Its transform $F(p, q)$ is observed to be essentially the discontinuity of a multiparticle scattering amplitude. External-field problems are studied to exhibit the physical content of the formalism. When $q = 0$ one recovers the single-particle distribution exactly. The equation of motion for $F(p, R)$ generates an infinite hierarchy of coupled equations for various distribution functions. In the Hartree approximation one obtains nonlinear integral equations analogous to the Vlasov equation in plasma physics. Such equations are convenient for exhibiting collective motions; in particular it appears that a collective mode exists in a ϕ^4 theory for a uniform infinite medium. It is speculated that such collective modes could provide a theoretical basis for clustering effects in multiparticle production. (auth)

32084 SPECTRAL-FUNCTION SUM RULES IN LAGRANGIAN FIELD THEORY: AN APPLICATION OF THE RENORMALIZATION GROUP. Weisberger, W.I. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. D 13: No. 4, 961-967 (15 Feb 1976).

Recent methods in applying the renormalization group are used to study the existence of spectral-function sum rules. A spurion expansion closely related to Wilson's original analysis is developed in the context of renormalized perturbation theory. Criteria for the validity of various types of sum rules are developed in terms of the anomalous dimensions of symmetry-breaking operators. Limitations on the order to which the spurion expansion can be carried because of infrared singularities are discussed. (auth)

32085 DYNAMICAL SYMMETRY BREAKING VIA A BOUND STATE AND A COMMENT ON THE O(N) σ MODEL. Haymaker, R.W. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Phys. Rev. D 13: No. 4, 968-973 (15 Feb 1976).

We analyze the sheet structure of the effective potential for relativistic field theories that have a bound state (mass m_B) and show that if $m_B{}^2$ goes negative the vacuum changes sheets avoiding tachyon problems and giving dynamical symmetry breaking if the bound state has quantum numbers. We illustrate a transition of this type in the O(N) -symmetric σ model for large N. We resolve a tachyon problem in this model noted by Coleman, Jackiw, and Politzer by finding the vacuum state of lowest energy. We show this model has no symmetry breaking of any kind in the leading $1/N$ approximation. Any symmetry breaking the tree in approximation level is restored dynamically. (auth)

32086 IMPLICATIONS OF DYNAMICAL SYMMETRY BREAKING. Weinberg, S. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts). Phys. Rev. D 13: No. 4, 974-996 (15 Feb 1976).

An analysis is presented of the physical implications of theories in which the masses of the intermediate vector bosons arise from a dynamical symmetry breaking. In the absence of elementary spin-zero fields or bare fermion masses, such theories are necessarily invariant to zeroth order in the weak and electromagnetic gauge interactions under a global $U(N) \otimes U(N)$ symmetry, where N is the number of fermion types, not counting color. This symmetry is broken both intrinsically by the weak and electromagnetic interactions and spontaneously by dynamical effects of the strong interactions. An effective Lagranigan is constructed which allows the calculation of leading terms in matrix elements at low energy; this effective Lagrangian is used to analyze the relative direction of the intrinsic and spontaneous symmetry breakdown and to construct a unitarity gauge. Spontaneously broken symmetries which belong to the gauge group of the weak and electromagnetic interactions correspond to fictitious Goldstone bosons which are removed by the Higgs mechanism. Spontaneously broken symmetries of the weak and electromagnetic interactions which are not members of the gauge group correspond to true Goldstone bosons of zero mass; their presence makes it difficult to construct realistic models of this sort. Spontaneously broken elements of $U(N) \otimes U(N)$ which are not symmetries of the weak and electromagnetic interactions correspond to pseudo-Goldstone bosons, with mass comparable to that of the intermediate vector bosons and weak couplings at ordinary energies. Quark masses in these theories are typically less than 300 GeV by factors of order α. These theories require the existence of "extra-strong" gauge interactions which are not felt at energies below 300 GeV. (auth)

32087 ASYMPTOTIC FREEDOM, POTENTIAL SCATTERING, AND HIGH-ENERGY LIMITS. Heckathorn, D.; Oehme, R. (Institut für Theoretische Kernphysik, Universität Karlsruhe, Karlsruhe, Germany). Phys. Rev. D 13: No. 4, 1003-1008 (15 Feb 1976).

The fixed singularities in the complex angular momentum plane of the amplitude are obtained for potentials which correspond to asymptotically free field theories. For potentials of the form $-g^2(r)\, r^{-2}$, with $g^2(r)$ decreasing logarithmically for $r \to 0$, one obtains an essential singularity with an accumulation of Regge poles. A somewhat faster decrease with the square of the logarithm gives a special branch point. These singularities replace the fixed cuts seen for $g^2(0) > 0$, which corresponds to renormalizable theories with a finite fixed point. The connection of our results with field-theory calculations is discussed. They are also considered from the point of view of the general analytic properties of amplitudes satisfying two-particle and multiparticle t-channel unitarity. In asymptotically free gauge theories, similar singularities may occur at $j = 1$. (auth)

32088 STRONG-COUPLING CALCULATIONS OF LATTICE GAUGE THEORIES: (1 + 1)-DIMENSIONAL EXERCISES. Banks, T.; Susskind, L. (Tel Aviv University, Tel Aviv, Israel); Kogut, J. Phys. Rev. D 13: No. 4, 1043-1053 (15 Feb 1976).

Strong-coupling methods for solving gauge theories formulated on a lattice are illustrated by studying the lattice version of the massive Schwinger model. The vacuum state of the model spontaneously break chiral symmetry and is equivalent to an Ising antiferromagnetic chain. Several lattice perturbation-theory calculations are carried out to fourth order in the dimensionless expansion parameter $1/g^2a^2$, where a is the lattice spacing. Padé approximants are then employed to extrapolate the calculation to large $1/g^2a^2$. Good agreement between these calculations and exact results on the continuum massive Schwinger model are found. (auth)

32089 REGGEON CUTTING RULES AND s-CHANNEL UNITARITY. Cardy, J.L. (University of California, Santa Barbara, California 93106); Suranyi, P. Phys. Rev. D 13: No. 4, 1064-1070 (15 Feb 1976).

We show that the cutting rules of Abramovskii, Kancheli and Gribov, for the discontinuities of enhanced Reggeon diagrams follow solely from the requirement that the total discontinuity of a diagram be equal to twice its imaginary part, together with the result that the diffractive discontinuity of the two-Reggeon cut be equal to minus its total discontinuity. This conclusion is already implied by low-order diagrams. We prove that it is consistent to all orders in perturbation theory. (auth)

32090 ILLUSTRATION OF AN ASYMPTOTICALLY FREE FIELD THEORY: THE ZACHARIASEN MODEL. Deshpande, N.G. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). Phys. Rev. D 13: No. 4, 1071-1075 (15 Feb 1976).

We study the exactly soluble relativistic-model field theory proposed by Zachariasen. Here we consider the more general model with Yukawa and Fermi couplings. The model thus admits a nontrivial vertex function as well as a propagator. Conventional renormalization is reviewed, and then renormalization is carried out at an arbitrary spacelike momentum. The equivalence of the two procedures is demonstrated. By setting up the equations for the Yakawa and Fermi constants at Euclidean momenta in terms of the one-mass-shell couplings, the asymptotic limit is taken. It is shown that both the Yukawa and Fermi constants vanish in the limit, thus providing an example of an asymptotically free theory. Since the model has an S-matrix formulation, we see the connection between the renormalization-group method and the point of subtraction in the N/D technique. The Gell-Mann-Low equations for the coupling are set up and solved exactly, again verifying the asymptotic freedom. (auth)

32091 BOSON-FERMION AND BOSON-BOSON SCATTERING IN A YANG-MILLS THEORY AT HIGH ENERGY: SIXTH-ORDER PERTURBATION THEORY. McCoy, B.M. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794); Wu, T.T. Phys. Rev. D 13: No. 4, 1076-1081 (15 Feb 1976).

We extend our previous study of Yang-Mills fields by calculating the high-energy behavior of the boson-fermion and of the boson-boson amplitude in sixth-order perturbation theory. In the isovector and isoscalar channels of both these processes the behavior of the amplitude is the same as that found in fermion-fermion scattering. (auth)

32092 HIGH-ENERGY BEHAVIOR OF NON-ABELIAN GAUGE THEORIES. Nieh, H.T. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794); Yao, Y. Phys. Rev. D 13: No. 4, 1082-1106 (15 Feb 1976).

This paper is a detailed account of a study in perturbation theory of the high-energy behavior of non-Abelian gauge theories. We calculate the fermion-fermion scattering amplitude up to sixth order in the

coupling constant in the high-energy limit $s \to \infty$ with fixed t, in the approximation of keeping only the leading logarithmic terms. Our results indicate that the high-energy behavior of non-Abelian gauge theories are complicated, and quite different from the known behaviors of other field theories studied so far. (auth)

32093 REGGEIZATION OF THE FERMION-FERMION SCATTERING AMPLITUDE IN NON-ABELIAN GAUGE THEORIES. Tyburski, L. (Department of Physics, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). Phys. Rev. D 13: No. 4, 1107-1130 (15 Feb 1976).

We have calculated the fermion-fermion scattering amplitude for a non-Abelian gauge theory with SU(N) gauge symmetry in the limit of high energy with fixed momentum transfer through sixth order in the coupling constant. We have kept only the leading logarithmic terms in each order of perturbation theory. In order to avoid the infrared problem, the Higgs mechanism is invoked to give masses to the vector bosons of the theory. We find that the scattering amplitude exponentiates to a Regge form. This result is qualitatively different from an earlier published calculation. (auth)

32094 COMMENT ON NEW SOLUTIONS TO THE CALLAN-SYMANZIK EQUATIONS. Nash, C. (Physics Department, Imperial College, London SW7, England). Phys. Rev. D 13: No. 4, 1134-1136 (15 Feb 1976).

Recently Ward has suggested that new inhomogeneous terms, due to threshold effects, control the asymptotic solutions for large momenta of the Callan-Symanzik equations. These can be shown on closer scrutiny to be absent. (auth)

32095 REPLY TO THE COMMENTS BY NASH ABOUT THE VIOLATION OF DIMENSIONAL ANALYSIS. Ward, B.F.L. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 13: No. 4, 1137-1139 (15 Feb 1976).

We reply to the comments by Nash about our approach to the partial differential equations of renormalizable quantum field theory. We present a simple example to support our claims. (auth)

32096 MAGNETIC CONFINEMENT IN NON-ABELIAN-GAUGE FIELD THEORY. Brout, R. (Faculté des Sciences, Université Libre de Bruxelles, Bruxelles, Belgium); Englert, F.; Fischler, W. Phys. Rev. Lett. 36: No. 12, 649-652 (22 Mar 1976).

A confined magnetic flux solution of finite length and finite energy, arising from non-Abelian-gauge theory, is presented. (auth)

32097 INFRARED PROBLEM IN NON-ABELIAN GAUGE THEORY. Yao, Y.-P. (Harrison Randall Laboratory, Department of Physics, University of Michigan, Ann Arbor, Michigan 48109). Phys. Rev. Lett. 36: No. 12, 653-656 (22 Mar 1976).

I extend the Bloch-Nordsieck idea to show that in the lowest nontrivial order of radiative correction the fermion-fermion and gauge-meson-fermion scattering rates are finite, provided that they are averaged over the initial and summed over the final internal spin states. Questions of the physical gauge coupling and infrared slavery are discussed. (auth)

32098 CLASSIFICATION OF UNQUANTIZED YANG-MILLS FIELDS. Eguchi, T. (The Enrico Fermi Institute, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. D 13: No. 6, 1561-1565 (15 Mar 1976).

A classification of unquantized Yang-Mills fields is given according to their algebraic and differential properties. A method is used which is similar to the one employed by Petrov and Schell in their classification of the vacuum gravitational field. It is proved that there is no inherently nonlinear solution to a sourceless Yang-Mills field in a vacuum. (auth)

32099 BOSON-FERMION CORRESPONDENCE IN TWO-DIMENSIONAL FIELD THEORIES. Bander, M. (Department of Physics, University of California, Irvine, California 92664). Phys. Rev. D 13: No. 6, 1566-1572 (15 Mar 1976).

The correspondence between boson and fermion field theories in one space and one time dimension is examined in the context of a path-integral formulation of these theories. The advantage of this formulation is that the translation, both for the Lagrangians and the field operators, is fairly automatic. Normalization of products of fields, which in more conventional formulations required careful manipulation of singular quantities, in this approach is a straightforward consequence of Lorentz invariance. (auth)

32100 NEW APPROACH TO THE SINGULARITIES OF FEYNMAN AMPLITUDES IN THE ZERO-MASS LIMIT. Kinoshita, T. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853); Ukawa, A. Phys. Rev. D 13: No. 6, 1573-1591 (15 Mar 1976).

We present an improved method for studying the behavior of Feynman amplitudes in the limit in which some or all of the masses of the internal lines vanish. Feynman amplitudes develop singularities in such a limit for certain configurations of external momenta. Our method enables us to determine these configurations, be they Euclidean or Minkowskian, on or off the mass shell. They are worked out explicitly in a few relatively simple cases which include most of the physically interesting singularities. Power-counting rules for these singularities are briefly discussed. (auth)

32101 DUALITY TRANSFORMATIONS OF ABELIAN AND NON-ABELIAN GAUGE FIELDS. Deser, S. (Physics Department, Harvard University, Cambridge, Massachusetts 02138); Teitelboim, C. Phys. Rev. D 13: No. 6, 1592-1597 (15 Mar 1976).

Duality transformations, i.e., rotations of electric and magnetic fields into each other, are implementable by a time-local generator for source-free Maxwell theory in an arbitrary spacetime metric. The Maxwell action $\int (E^2 - B^2)$ as well as the stress tensor components, e.g., $E^2 + B^2$, are duality invariant and the generator is conserved. In the formally analogous Yang-Mills case, duality transformations cannot even be consistently implemented. (auth)

32102 MULTILOOP CALCULATIONS IN THE σ MODEL. Margulies, M. (Columbia University, New York, New York 10027). Phys. Rev. D 13: No. 6, 1621-1641 (15 Mar 1976).

The energy density of a system of fermion fields interacting with scalar and pseudoscalar fields in the presence of an external source linearly coupled to the scalar field is calculated. This is done by expanding the energy density in a sum of loop diagrams. The quantity computed is of direct interest for the study of the possible existence of abnormal nuclear states, first hypothesized by Lee and Wick. It may also be of relevance to other outstanding problems in hadron physics. The calculation is done within the context of a theory which exhibits spontaneous symmetry breaking at the tree level. The method used is designed with the goal in mind of retaining in the final answer the symmetry originally present in the Lagrangian density L and explicitly shows how to avoid the infrared difficulties associated with the presence of a massless fermion field in L. (auth)

32103 ABNORMAL NUCLEAR STATES: HIGHER-ORDER CORRECTIONS TO THE SEMICLASSICAL SOLUTION. Margulies, M. (Columbia University, New York, New York 10027). Phys. Rev. D 13: No. 6, 1642-1648 (15 Mar 1976).

Quantum corrections to the semiclassical expression for the energy density of a dense fermion medium interacting with a scalar-meson field are computed. More specifically, all second-order terms in the previously introduced high-density, weak-coupling expansion are calculated. It is found that the resulting correction is not independent of the scalar-field vacuum expectation values, as was found to be the case for the first-order term. (auth)

32104 INFRARED STRUCTURE OF THE LEADING CONFORMAL CONTRIBUTION TO THE ELECTROMAGNETIC VERTEX FUNCTION. Menotti, P. (Scuola Normale Superiore and Istituto Nazionale di Fisica Nucleare, Sezione di Pisa, Pisa, Italy). Phys. Rev. D 13: No. 6, 1778-1790 (15 Mar 1976).

We treat the infrared problem directly related to the asymptotic behavior of the form factor of a particle belonging to the fermion-antifermion channel, with anomalous dimension $\bar{d}$. For $\bar{d} < 2$ we relate it to the off-shell vertex function; for $\bar{d} > 2$ we examine the triangle graph which is considered to be the most infrared divergent. We show that the leading γ_5-even conformal contribution to the wave function does not give rise to infrared divergences, provided the dimensions of the various fields satisfy the conformal bounds. Thus the ensuing contribution to the asymptotic form factor is $(-q^2)^{1-\bar{d}}$. (auth)

32105 ASTROPHYSICAL RELEVANCE OF "QUANTUM ELECTRODYNAMICS IN A PHOTON SEA". Chau, W.Y. (Astronomy Group, Physics Department, Queen's University, Kingston, Ontario, Canada); Wong, T.F. Phys. Rev. D 13: No. 6, 1805-1806 (15 Mar 1976).

The shift in the hydrogen ground-state energy level as a result of background photon corrections is worked out explicitly. This is then used in the discussion of possible astrophysical significance, in particular for normal, stable stellar configurations where we show that the shift would be masked by "classical" line broadening. (auth)

32106 SEMICLASSICAL QUANTIZATION OF THE MASSIVE THIRRING MODEL. Marques, G.C.; Ventura, I. (Instituto de Física, Universidade de São Paulo, C. Postal: 20516-São Paulo, São Paulo, Brasil). Phys. Rev. D 13: No. 6, 1807-1808 (15 Mar 1976).

The "Bohr-Sommerfeld quantization rule" is used in the treatment of the massive Thirring model. A semiclassical bound-state spectrum is achieved. This spectrum is similar to that of the sine-Gordon theory. (auth)

32107 NONCOVARIANCE OF THE COULOMB-GAUGE SCHWINGER MODEL. Hagen, C.R. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 13: No. 6, 1813-1815 (15 Mar 1976).

Formal proofs of the covariance of gauge theories in two-dimensional space-time are questionable in the Coulomb gauge in view of the highly

singular nature of the inverse Laplacian. It is shown that such considerations do in fact destroy the covariance of the Schwinger model as well as that of the more general non-Abelian gauge theory. (auth)

32108 COMMENT ON THE MASS AND UNIQUENESS CONDITIONS FOR HOMOGENEOUS INVARIANT EQUATIONS. Cotăescu, I.I. (Department of Physics, University of Timişoara, Timişoara, Romania). Phys. Rev. D 13: No. 6, 1816-1819 (15 Mar 1976).

It is shown that if more general mass and uniqueness conditions than those of Harish-Chandra and Tung are used, a new class of relativistic invariant equations for unique mass and spin can be derived. (auth)

Gravitation and General Relativity

Refer also to abstracts 30634–30637, 30686, 30828, 30834, 31396, 31417, 32059–32061, 32075, and 32076.

32109 CORRELATION FUNCTIONS AND DYNAMICAL STRUCTURE FACTOR OF NONISOTROPIC MEDIUM NEAR THE CRITICAL POINT. II. Classical Fluid in Gravitational Field. Sysoev, V. M.; Chalii, A. V. (Kiev State Univ.). Teor. Mat. Fiz.; 26: No. 1, 126-136(Jan 1976). (In Russian).

Analytical properties of the space-time correlation function of hydrodynamical density fluctuations, which determine the features of the critical opalescence spectrum of nonisotropic fluid in gravitational field, are investigated. The results of the thermodynamic and dynamic scaling theory are used for evaluating the temperature and space dependence of the hydrodynamical equations coefficients. (auth)

32110 SPIN AND TORSION IN GENERAL RELATIVITY: FOUNDATIONS, AND IMPLICATIONS FOR ASTROPHYSICS AND COSMOLOGY. Kerlick, G. D. Princeton, NJ; Princeton Univ. (1975). 191p. University Microfilms Order No. 76-253.

Thesis (Ph. D.).

A generalization of Einstein's general relativity due to Cartan, Sciama, and Kibble [ECSK] is reviewed, in its geometrical aspects and in its physical aspects. The foundations of the theory are examined from the point of view of local gauge invariance and the geometrical language of fibre bundle theory. Here is shown for the first time that that variance under spacetime translations leads to Einstein's theory, and that local Lorentz invariance, which by itself leads to no satisfactory physical theory, can be related to the contortional degree of freedom in the Riemann–Cartan geometry of ECSK. Local invariance under the full Poincaré group leads to the ECSK theory, as shown by Kibble. It is shown that the spacetime local gauge theory of the Poincaré group has a very natural interpretation as Riemann–Cartan geometry, which is visible in the isomorphism between the generalized curvature of the bundle of affine orthonormal frames on one hand and the generalized curvature of the principal bundle of the Poincaré group on the other. Simple solutions of the Dirac equation in Riemann-flat spacetimes with torsion are examined, and from this examination it is found that the gravitational spin-spin interaction which distinguishes ECSK from general relativity is attractive between electrons, positrons, neutrinos, and antineutrinos whenever their spin polarizations are aligned. A brief investigation of stellar models in ECSK theory concludes that gravitational spin-spin effects are overwhelmed by magnetic effects and the effects of rotation, so that no observational confirmation of torsion effects is possible. Cosmological models with torsion are studied for matter described as convective "spinning dust" and for matter fields which solve the ECSK–Dirac equations. The theorems of Hawking and Penrose on the formation of singularities are extended to ECSK. The effect of rotation of the cosmological fluid is estimated. Finally, it is discovered that the picture of particle creation in the early universe is drastically altered for densities greater than 10^{55} g cm^{-3}, where the effect of spin on geometry begins to dominate the effect of mass on geometry. (Diss. Abstr. Int., B)

32111 POSITIVE ENERGY CONJECTURE. Jang, P. S. (Univ. of Chicago). J. Math. Phys. (N.Y.); 17: No. 1, 141-145 (Jan 1976).

A theorem, to the effect that the positive energy conjecture is true for any space–time possessing a flat spatial hypersurface, is obtained. (auth)

32112 VERIFYING THE GRAVITATIONAL SHIFT DUE TO THE EARTH'S ROTATION. Briatore, L. (Univ., Turin); Leschiutta, S. Lett. Nuovo Cim.; 15: No. 6, 203-207(7 Feb 1976).

The results, obtained by elaborating data from various independent time scales, are presented showing local verification of the gravitational shift or the measurement of proper time scale comparisons of the effect due to height differences or to the earth's rotation. (JFP)

32113 KERR–SCHILD CONGRUENCE AND SHEAR. Misra, M. (Gujarat Univ., Ahmedabad, India). Vidya; 17: No. 1, 90-95 (1974).

The necessary and sufficient conditions for the Kerr–Schild congruence to be shear-free without the use of any field equations are studied. (auth)

32114 CURIOUS COSMOLOGICAL SOLUTION OF EINSTEINS EQUATIONS. Patel, L. K. (Gujarat Univ., Ahmedabad, India). Vidya; 17: No. 1, 73-75(1974).

32115 STATIC AXIALLY SYMMETRIC SOLUTIONS OF THE ALREADY-UNIFIED-FIELD. Gopalarao, A. V.; Srinivasarao, K. N. (Mysore Univ., India). Proc. Indian Natl. Sci. Acad., Part A; 39: No. 2, 112-118(1973).

Some static solutions possessing axial symmetry were obtained for the coupled Einstein–Maxwell equation using the Rainich-Misner-Wheeler equation of the already-unified-field theory. Electromagnetic fields and the corresponding sources are discussed for a few special cases. The coupled fields so obtained shed some light on the nature of the charged-line-mass in the general theory of relativity.

32116 SOLUTION OF THE INVERSE GRAVIMETRIC PROBLEM USING THE SIMPLEX METHOD. Ivanova, P. K. (Geophysical Inst., Sofia). C. R. Acad. Bulg. Sci.; 28: No. 10, 1371-1373(1975).

An algorithm is suggested for the solution of the inverse gravitational problem by means of point masses, whose number is determined by the complexity of the anomalous field, corresponding to the gravitating body of a complicated shape. (JFP)

32117 TESTS FOR *C*, *P* AND *T* NONCONSERVATION IN GRAVITATION. Dass, N.D.H. (The Niels Bohr Institute, Copenhagen University, DK-2100 Copenhagen Ø, Denmark). Phys. Rev. Lett. 36: No. 8, 393-395 (23 Feb 1976).

The question of *C*, *P*, and *T* nonconservation in gravity is reexamined, and feasible experiments are suggested to test these effects. (auth)

32118 SIGNAL-FRONT GRAVIDYNAMICS OF VECTOR FIELDS IN THE RAY GAUGE. Aragone, C.; Restuccia, A. (Departamento de Física, Universidad Simón Bolívar, Apartado Postal 5354, Caracas 108, Venezuela). Phys. Rev. D 13: No. 2, 207-217 (15 Jan 1976).

The dynamical evolution of a gravitating vector field (massive or massless) is analyzed along a signal-front coordinate (or null coordinate). Moreover, we specialize our frame of reference by adding the ray-gauge condition, which essentially consists of taking the affine parameter of the null geodesics contained in the signal-front hypersurfaces as the second kind of nonspatial coordinate. Then we extend previous results of Aragone and Chela Flores to this matter-source case. We exhibit the algebraic and differential constraints for the present system, and the reduction process is accomplished. It is shown how the gravidynamics of the vector fields can be studied in terms of the minimum number of independent physical fields, half the usual timelike canonical first-order approach. It is found that the signal-front energy density is always nonnegative. Moreover, the connection between vanishing signal energy fields and the Robinson-Trautman and Kundt plane radiative solutions is also shown. Finally, the limit of the matter signal energy, when the mass tends to zero, is shown to be (even in an arbitrary nonflat background) the sum of the related Maxwell signal energy plus the signal energy of a scalar massless field. (auth)

32119 NULL-COORDINATE GRAVIDYNAMICS AND THE SPIN COEFFICIENTS. Aragone, C. (International Centre for Theoretical Physics, Trieste, Italy); Gambini, R.; Restuccia, A. Phys. Rev. D 13: No. 2, 218-223 (15 Jan 1976).

By choosing a very natural tetrad we show that the null-energy density, found previously by two of us from a first-order action principle, is four times the modulus squared of the Newman-Penrose coefficient τ. Moreover, we compute in terms of the usual tensorial field variables of gravity the more important three tetradic scalars of the conformal Weyl tensor. Consequently, we are able to write down the mass formulas in terms of the field variables. Also given is a null-energy formula in terms of line and surface integrals. All the results are given for fields which are asymptotically flat and asymptotically "uniformly smooth." (auth)

32120 GEOMETRICAL APPROACH TO LOCAL GAUGE AND SUPERGUAGE INVARIANCE: LOCAL GUAGE THEORIES AND SUPERSYMMETRIC STRINGS. Chang, L.N. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174); Macrae, K.I.; Mansouri, F. Phys. Rev. D 13: No. 2, 235-249 (15 Jan 1976).

A geometrical analysis of local gauge invariance is presented. By extending the four directions in space-time which can define a light cone to an enlarged tangent space, we construct a superspace in which the intimate relationship between purely kinematic invariances and those of local internal symmetry groups are explored. Three applications

are considered: (1) Local gauge theories in flat or curved space-time are derived from a scalar action in superspace. As a result, the theory has an extra dimensional parameter. (2) Born-Infeld electrodynamics and its non-Abelian counterpart are extended to curved space-time. This suggests a new set of gravitational field equations. (3) The formalism is extended to the case in which the connection forms anticommute and supersymmetric string models are constructed, which give action-principle formulations of the known dual models involving fermions and suggest possibilities for constructing new models. Applications to gravitation and local supersymmetry are pointed out. (auth)

32121 RELATIVISTIC GRAVITATIONAL ENERGY IS PROBABLY LOCALIZABLE. Chevalier, J. (Univ., Geneva). Helv. Phys. Acta; 48: 619-624(1975).

Scherrer's linear theory and the tetradic formalism lead to a covariant representation of gravitational energy-momentum (GEM) in general relativity. Unfortunately, the GEM-density is not invariant under transformations of tetrads, and this defect seems to be as awkward as the well-known difficulties of the Einsteinian GEM-complex. Some authors, Moller for instance, suggested supplementary conditions to determine tetrads without ambiguity, but their considerations are of a purely mathematical nature. In the static case, a physically well-founded variational principle is formulated. The resulting field equations plus suitable boundary conditions determine the tetrads unambiguously. In this formalism, gravitational energy is thus quite localizable. (auth)

32122 SCALING INVARIANCE AND EQUATIONS OF GRAVITATIONAL FIELDS. Stanyukovich, K. P. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 6-22(1975). (In Russian)

32123 EXTENSION OF THE SOLUTION OF THE EQUATIONS OF THE GENERAL THEORY OF RELATIVITY THROUGH SINGULARITIES. Gretsenshtein, M. E.; Konstantinov, M. Yu. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 23-31(1975). (In Russian)

32124 CONFORM TWO-DIMENSIONAL NON-STEADY SOLUTIONS IN THE GENERAL THEORY OF RELATIVITY AND SCALAR-TENSOR THEORIES OF GRAVITATION. Zaitsev, N. A.; Shikin, G. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 31-38(1975). (In Russian)

32125 SELF-MODELING TYPE OF NON-STEADY SOLUTIONS OF A SYSTEM OF EINSTEIN EQUATIONS AND EQUATIONS OF MASSLESS SCALAR FIELDS IN ORTHOGONAL METRICS. Shikin, G. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 38-41(1975). (In Russian)

32126 STUDY OF TWO PRECISE SELF-MODELING SOLUTIONS OF THE EQUATIONS OF THE GENERAL RELATIVITY THEORY. Ivanov, M. Yu. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 41-48(1975). (In Russian)

32127 CENTRAL-SYMMETRICAL NON-STEADY SOLUTIONS IN SCALAR-TENSOR THEORIES OF GRAVITATION. Dorodnykh, V. S.; Fedoseev, I. A. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 49-54(1975). (In Russian)

32128 GREEN FUNCTION OF KLEIN-GORDON COVARIANT EQUATIONS AND DIRAC EQUATIONS IN AN EXTERNAL GRAVITATIONAL FIELD. Liberman, N. M. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 55-59(1975). (In Russian)

32129 GRAVITATIONAL RADIATION AND COORDINATE CONDITIONS. Petrova, N. M.; Fedorova, S. P. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 83-87(1975). (In Russian)

32130 ONE NEGATIVE RESULT IN THE THEORY OF GRAVITATIONAL RADIATION. Shteingrad, Z. A.; Fedorova, S. P. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 87-91(1975). (In Russian)

32131 ZERO VALUE OF THE SCHWARZSCHILD MASS FOR A CLASS OF ASYMPTOTIC EUCLID SPACE-TIME. Folomeshkin, V. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 91-96 (1975). (In Russian)

32132 PLANE-WAVE SOLUTIONS OF EINSTEIN EQUATIONS WITH COSMOLOGICAL TERMS IN THE WEAK FIELD APPROXIMATION. Zakharov, V. D.; Sidorov, V. M.; Stanyukovich, K. P. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 97-108(1975). (In Russian)

32133 GRAVITATIONAL RADIATION OF A CHARGE IN A MAGNETIC FIELD. Gal'tsov, D. V.; Loskutov, Yu. M.; Sokolov, A. A.; Ternov, I. M.; Khalilov, V. R. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 108-121(1975). (In Russian)

32134 GRAVITATION, SPIN, CURVATURE. Krechet, V. G.; Lapchinskii, V. G.; Ponomarev, V. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 139-146(1975). (In Russian)

32135 RADIATIONLESS SPHERICAL COLLAPSE IN THE PRESENCE OF SCALAR FIELDS. Pavlov, N. V.; Bronnikov, K. A.; Koval'chuk, M. A. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 146-159(1975). (In Russian)

32136 POSSIBLE VERIFICATION OF THE EQUIVALENCE PRINCIPLE AT THE LEVEL OF GRAVITATIONAL INTERACTIONS. Kolosnitsyn, N. I.; Mikheev, V. M.; Osipova, A. V. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 171-181(1975). (In Russian)

32137 GRAVITATIONAL-ELECTROMAGNETIC RESONANCE. Menskii, M. B. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 181-190(1975). (In Russian)

32138 TEST ON THE PRODUCTION AND PRECISE MEASUREMENT OF A LARGE CYLINDRICAL TEST MASS FOR EXPERIMENTS ON THE DETERMINATION OF GRAVITATIONAL CONSTANTS. Kazhutin, N. G.; Tabenkin, A. N.; Kliot, L. A. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 197-204(1975). (In Russian)

32139 QUANTITATIVE DESCRIPTION OF THE MACH PRINCIPLE AND POSSIBILITY OF GRAVITON DECAY IN THE NASCENT STATE. Zavel'skii, A. S. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 213-218(1975). (In Russian)

32140 EMPIRICAL FORMULA FOR THE PAIR INTERACTION CONSTANT. Gertsenstein, M. E.; Solovei, L. G. Probl. Teor. Gravitatsii Elem. Chastits; No. 6, 218-222(1975). (In Russian)

32141 PRECESSION IN GENERAL RELATIVITY. Faridi, A. M. New York; New York Univ. (1975). 89p. University Microfilms Order No. 75-28,528.

Thesis (Ph. D.).

A generalization of Killing's equation is made in connection with the concept of precession. The new vector field generates groups of transformations leading to metrical deformations of space-time manifolds. The construction made is such that the generalized Killing's equation is still linear, and reduces to the Killing case for a vanishing deformation parameter. The precession of any physical quantity may take place with either a constant or variable speed. Most of the work is concerned with the special case of uniform precession. In this case one can give a Lie algebraic structure to these deformation generators analogous to those of rotation groups in three dimensions. The form of our definition of precession proves to be useful in discussing precession with variable speed. This fact has been utilized for an interpretation of Carter integral for the metric of a slowly spinning black hole. For the case of uniform precession, an n-dimensional flat space solution is obtained, and a theorem establishing the condition under which the solution exists is proven. Several solutions of these equations on two-dimensional Riemannian spaces are given; in particular, a deformed spherical surface is constructed. The geometrical properties of these solutions are discussed, and their dynamical contents are exemplified. A second-order linear system of equations is discussed. The precessing quantity in this case is described by the familiar equation of the harmonic oscillator. (Diss. Abstr. Int., B)

32142 FIRST-ORDER EQUATIONS FOR GRAVITATIONAL FIELD IN VACUUM. Fedorov, F. I.; Kirillov, A. A. (Inst. of Physics, Minsk). Acta Phys. Pol., Ser. B7: No. 3, 161-167(Mar 1976). (In Russian)

The Einstein vacuum field equations are represented as a system of the first-order equations with the quadratic nonlinearity in field functions. Different variants of these equations are investigated, in particular the system of equations permitting the Lagrangian formulation. This method leads to the energy-momentum pseudotensor of the gravitational field which equals to the half-sum of the Einstein pseudotensor and the Moeller-Mitskievic pseudotensor. (auth)

32143 SOME PHYSICO-GEOMETRICAL REMARKS ON SPINORS IN GENERAL RELATIVITY. Ikeda, S. (Tokyo Univ.). Lett. Nuovo Cim.; 15: No. 8, 265-268(21 Feb 1976).

A certain kind of unified field between the gravitational field and the spinor field was constructed, and can be applied to the unified theory of mass and spin. Some remarks are presented on these aspects from the standpoint of the geometrical theory of physical field. (JFP)

32144 PROPERTIES OF NON-SCHWARZSCHILD GRAVITATIONAL LENSES. Ingel', L.K. Sov. Astron.-AJ 19: No. 4, 444-449 (July 1975).

The focusing properties of very simple non-Schwarzschild gravitational fields are considered. Such gravitational lenses would have some interesting features. In particular, it is shown for the first time that two-dimensional caustics would exist; they should be taken into account when assessing the probability that the gravitational-lens effect might be observable. Certain errors and inaccurate statements by previous authors are pointed out. (auth)

32145 PROJECTIVE INVARIANCE AND THE FIFTH COORDINATE. Asanov, G. S. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 7, 71-75(1975). (In Russian).

The consequences of the principle of parametric (projective) invariance in the context of the general variation problem for stationary curves in four-dimension space-time were examined. The examination led to the necessity for the introduction of a parameter along the trajectory as a fifth coordinate. The condition of its cylindricity acquires a clear meaning during this operation. The projective invariants were examined for the trajectories of a test charged mass in a gravielectr magnetic field. It was shown that one of them coincides with the density of the electromagnetic field Lagrangians. (tr-auth)

32146 DIFFERENTIAL CROSS SECTIONS FOR WEAK-FIELD GRAVITATIONAL SCATTERING. Peters, P.C. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. D 13: No. 4, 775-777 (15 Feb 1976).

Differential cross sections are presented for the scattering of plane scalar, electromagnetic, and gravitational waves from the gravitational field of sources in the weak-field approximation. Comparison is made with the long-wavelength limit of analogous scattering off of spherical black holes. (auth)

32147 REGULAR SOLUTION OF 't HOOFT'S MAGNETIC MONOPOLE MODEL IN CURVED SPACE. van Nieuwenhuizen, P.; Wilkinson, D. (Institute for Theoretical Physics at State University of New York, Stony Brook, New York 11794); Perry, M.J. Phys. Rev. D 13: No. 4, 778-784 (15 Feb 1976).

A regular solution of 't Hooft's magnetic monopole model in curved space is presented. As in flat space, an analytical solution seems impossible, but by using the Einstein equations to eliminate the gravitational degrees of freedom, a positive-definite energy functional is constructed, which at its minimum gives both the required solution and the energy of the system. To first order in the gravitational constant G, the energy can be expressed in terms of the flat-space solutions only, whereas for general G a positive lower bound is derived. (auth)

32148 NULL GEODESIC DEVIATION. II. THE SCHWARZSCHILD METRIC. Peters, P.C. (Department of Physics, University of Washington, Seattle, Washington 98195). J. Math. Phys. (N.Y.) 17: No. 4, 546-553 (Apr 1976).

The equation of geodesic deviation is solved in the Schwarzschild geometry in a covariant manner. The solution is exact for null geodesics, and is given as an integral equation otherwise. The solution is then used to evaluate second derivatives of the world function and derivatives of the parallel propagator, which need to be known in order to find the Green's function for wave equations. The method of null geodesic limits is used to calculate higher order derivatives, and the results are applied to the scalar Green's function in the Schwarzschild geometry. (auth)

32149 GEOMETRICAL OPTICS IN GENERAL RELATIVITY: A STUDY OF THE HIGHER ORDER CORRECTIONS. Anile, A.M. (Seminario Matematico, Universitá degli Studi, 95100 Catania, Italy). J. Math. Phys. (N.Y.) 17: No. 4, 576-584 (Apr 1976).

The higher order corrections to geometrical optics are studied in general relativity for an electromagnetic test wave. An explicit expression is found for the average energy–momentum tensor which takes into account the first-order corrections. Finally the first-order corrections to the well-known area-intensity law of geometrical optics are derived. (auth)

32150 FURTHER HEAVENLY METRICS AND THEIR SYMMETRIES. Finley, J.D. III; Plebański, J.F. (Centro de Investigacion y de Estudios Avanzados del I.P.N., AP 14-740, México 14, D.F., Mexico). J. Math. Phys. (N.Y.) 17: No. 4, 585-596 (Apr 1976).

New developments in a continuing investigation of complex V_4's with purely self-dual conformal curvature are presented: (1) conformal and projective extensions of spaces with $C_{ABCD} = 0$ are discussed; (2) Killing vectors for general heavenly metrics are determined; (3) the solutions, in heavenly spaces, for (massless) D (0,s) spinor fields (in particular, the Maxwell field) are found; then (4) new examples of heavenly metrics of types $G\times[-]$ and $D\times[-]$ are provided; lastly, contraction of the $D\times D$ solutions of Plebański and Demiański to type $D\times[-]$ is performed, giving a complex prototype of the Kerr–Newman solution, and all solutions of the type $N\times[-]$ are given, which contain two arbitrary functions of two variables. (auth)

32151 INITIAL-VALUE PROBLEM OF GENERAL RELATIVITY. III. COUPLING FIELDS AND THE SCALAR-TENSOR THEORY. Isenberg, J.A. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540); O'Murchadha, N.; York, J.W. Jr. Phys. Rev. D 13: No. 6, 1532-1537 (15 Mar 1976).

The initial-value problem of general relativity is treated in the case where the external sources are electromagnetic or neutrino fields. Taking into account the initial conditions that must be satisfied by these fields, we show that the resulting equations in each case form a quasilinear elliptic system of a type that has been treated extensively in previous work. We also treat the initial-value problem of the scalar-tensor theory of gravitation. Throughout this work we use first-order "canonical" gravitational variables. The principal mathematical tools are conformal transformations and a covariant decomposition of symmetric tensors. (auth)

32152 CONSEQUENCES OF NONLINEARITY IN THE GENERALIZED THEORY OF GRAVITATION. Kurşunoğlu, B. (Center for Theoretical Studies, University of Miami, Coral Gables, Florida 33124). Phys. Rev. D 13: No. 6, 1538-1560 (15 Mar 1976).

This paper contains, for the time-independent spherically symmetric fields, various regular solutions of the field equations. The spectrum of magnetic charges g_n, $n = 0,1,2,...$, with alternating signs has been obtained as a function of mass where $g_n \to 0$ for $n \to \infty$ and where $\Sigma_{n=0}^{\infty} g_n = 0$. The neutral magnetic core of an elementary particle consists of an infinite number of stratified layers containing magnetic charges of amounts g_n. The screening caused by the stratified distribution of magnetic charges generates short-range forces. The strength of the coupling between the field and particle is described by $e^2 + g^2_n$, where $n = \infty$ corresponds to the distances beyond which there are no short-range forces. The observed mass M of a particle or antiparticle is obtained, as a consequence of the equations of motion, in the form $Mc^2 = mc^2/2 + 2E_n$, where E_n is the finite self-energy of the particle (or antiparticle) and where m and E_n have opposite signs. The "bare gravitational mass" m, obtained as a constant of integration, is estimated to be of the order of 10^{21} MeV. The spectrum of fundamental lengths $r_{0n} \{ = [(2G_0)^{1/2}/c^2]\ (e^2 + g^2_n)^{1/2} \sim 10^{-33}$ cm$\}$ measures the deviation of the theory from general relativity. The self-energy E_n in the limit $r_{0n} = 0$ tends to infinity and the solutions reduce to the corresponding spherically symmetric solutions in general relativity. The spin 1/2 of an elementary particle is found to be the result of the assumption $g^2_n = \gamma_n \hbar c$ with $\lim_{n\to\infty} \gamma_n = 0$ and its neutral magnetic structure, where the latter exists only for nonvanishing $\Gamma^{\rho}_{[\mu\nu]}$, the antisymmetric part of the affine connection. The two states of spin correlate with the two possible sequences of signs of g_n, i.e., g_n and $-g_n$, $n = 0,1,2,...$. For the solutions where $e = 0$ the symmetries of charge conjugation and parity are not conserved. The latter lead to the assumption of small masses for the two neutrinos ν_e, ν_μ. Conservation of the electric charge multiplicity, i.e., the existence of $-1, +1, 0$ units of electric charge, is found to be the basis for the existence of four massive fundamental particles p, e, ν_e, ν_μ and the corresponding antiparticles $\bar{p}$, e^+, $\bar{\nu}_e$, $\bar{\nu}_\mu$. Based on a new concept of "vacuum" and new magnetic charge predicted by the theory it may be possible to construct all other elementary particles as bound or resonance states of the "fundamental quartet" p, e, ν_e, ν_μ and the "antiquartet" $\bar{p}$, e^+, ν_e, ν_μ. (auth)

32153 MAXWELL FORM OF THE LINEAR THEORY OF GRAVITATION. Campbell, W.B.; Morgan, T.A. (Behlen Laboratory of Physics, University of Nebraska, Lincoln, Nebraska 68508). Am. J. Phys. 44: No. 4, 356-365 (Apr 1976).

A treatment of the linear theory is given that closely parallels the usual E and B formulation of electromagnetic theory. In Part I, an introductory exposition of gravitational radiation is presented. The tidal gravitational field strength E is defined, and it is shown that E is the measurable quantity which characterizes a gravitational wave. The important point is made that the problem of detecting gravitational waves is really the same problem as detecting tidal accelerations due to a time-varying Newtonian gravitational field. In Part II, the magnetic-type gravitational field strength B is defined and Maxwell-like field equations are used to determine the polarization states of a gravitational wave. The detection of gravitational waves by Weber-type cylinders is discussed. (auth)

32154 STABILITY OF A POLYTROPIC PLATE IN GENERAL RELATIVITY. Horsky, J. (Univ., Brno); Chubaryan, E.V.; Papoyan, V.V. Bull. Astron. Inst. Czech.; 27: No. 2, 115-125 (1976).

The problem of stability with respect to small perturbations of a thick plane plate, formed by a polytropic substance, is studied. It is proved that these configurations are more stable with respect to small perturbations as compared to the spherically symmetric case. (auth)

REACTOR TECHNOLOGY AND REGULATION

Refer also to abstracts 31230, 31932, and 32248.

32155 (ERDA-tr-116) BONN COULD INDIRECTLY HELP BRAZIL BECOME A NUCLEAR POWER INTERNATIONAL ATTENTION PAID ATTITUDE OF FEDERAL GOVERNMENT. The Sale of Nuclear Plants Has Inherent Safety Risks. Gillessen, G. 1975. Translation of German Report. 4p. Dep. NTIS $3.50.

The possible effects of the sale of nuclear power plants and associated reprocessing facilities to Brazil by German enterprises are examined.

32156 (EUR-5260) 1973 ISPRA–J.R.C.–ANNUAL REPORT. Angelini, A. (Commission of the European Communities, Brussels (Belgium)). Dec 1974. 453p. INIS.

A comprehensive review of the work carried out during 1973 in the Ispra establishment of the Joint Research Center is presented. A description is given of the activity carried out in the frame of the so-called objectives of the 1973 research program. Some of the most relevant scientific and technical achievements are described. The operation of the big installations is reported. The technical and administrative support activities are also treated. A bibliography of reports, contributions to conferences, seminars and meetings etc. is given.

32157 (IGN-117) ANNUAL REPORT 1973-1974. Amyot, L. (Ecole Polytechnique, Montreal, Quebec (Canada). Inst. de Genie Nucleaire). 25 Jun 1974. 36p. (In French). INIS.

The objectives, personnel complement, education programs, research programs, exterior affairs, publications, and budget are described for the Institut de Genie Nucleaire for the period June 1973–May 1974.

32158 (INIS-mf-1871) ATOMIC ENERGY BOARD, EIGHTEENTH ANNUAL REPORT, 1974. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). 1974. 64p. INIS.

Progress is reported on the following: nuclear materials, nuclear power, application of radioisotopes and radiation, health and safety and fundamental studies undertaken in physics, chemistry, metallurgy, medicine and geology during 1974. The technical activities on the site are summarized as well as the external negotiations undertaken. The staff organization and finance is given. The report also contains a list of publications published during 1974 by staff members and bursars of the Board.

32159 (INIS-mf-1872) A REVIEW OF NUCLEAR POWER TECHNOLOGY. Brown, K. T. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). 1975. 60p. INIS.

From energy and its future in Southern Africa; Cape Town, South Africa (28 Apr 1975).

Organized by the Energy Utilization Unit, University of Cape Town.

World energy resources and basic information regarding the fission process are briefly discussed, pointing out the eventual need for breeder reactors. Current reactors which form part of electricity generating programs are described, such as PWR, BWR, CANDU PHW, and SGHWR, with brief mention of Magnox and AGR types. More advanced reactors which are expected to play increasing roles in the future are also described, such as HTR, LMFBR and GCFBR. The elements of fuel cycles are outlined, and a section concerning some LWR safety aspects and waste disposal are included. A brief consideration of the future predicts uranium requirements and mentions the possible rate of introduction of advanced types of reactors into nuclear power programs.

32160 (INR-P-1451/23/R/C) MATHEMATICAL METHODS AND COMPUTER PROGRAMS AS APPLIED TO THE NUCLEAR POWER PLANNING IN POLAND. Frankowski, W.; Podpora, J.; Jurkowski, M.; Kazimierski, T. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 14p. INIS.

From symposium on mathematical modes of sectors of the energy economy; Alma-Ata, USSR (3 Sep 1973).

In connection with the nuclear power planning at the Institute of Nuclear Research, 11 computer programs have been used. Both mathematical simulation and optimization techniques (linear and nonlinear programming) are in use. The study brought a lot of detailed results and a broad range of knowledge and background information as well. The work is being continued. (auth)

32161 (PAEC(A)-7501) ANNUAL REPORT, 1973-1974. (Philippine Atomic Energy Commission, Manila). 1975. 163p. INIS.

Suppl. 33 p.

The activities of the Philippine Atomic Energy Commission for the fiscal year 1973-1974 are summarized. Highlights of the report are the following: (1) research and development; (2) technical services; (3) regional cooperation; (4) education and training; (5) foreign technical assistance; (6) cooperative services; (7) international conferences and visits; (8) program of future activities. Lists of participants of both local and overseas training program and licenses issued for the fiscal year are also included.

32162 (TID-8200-R33) NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED IN THE UNITED STATES AS OF DECEMBER 31, 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Development and Demonstration). Apr 1976. 44p. Dep. NTIS $4.00.

A compilation is presented which contains unclassified information about facilities built, being built, or planned in the United States for domestic use or export as of Dec. 31, 1975, which are capable of sustaining a nuclear chain reaction. Information is presented in five parts, each of which is categorized by primary function or purpose. The major parts, namely, civilian, military, production, and export, as well as such categories as power and propulsion, are self-explanatory.

32163 (UCRL-Trans-10764) NEW POSSIBILITIES FOR UNDERGROUND GASIFICATION BY THE PRESSURE CHANGE PROCESS AND BY INJECTION OF HEAT FROM NUCLEAR REACTORS. Wenzel, W.; Franke, F. H.; Meraikib, M. Translated from Glueckauf-Forschungsh.; 33: No. 4, 1-6(Aug 1972). 18p. Dep. NTIS $3.50.

The proposed intermittent pressure change process for underground gasification of coal consists of the heated gasification agent being introduced into the prepared deposits in the increased pressure phase under pressure and it remains during the conversion phase. In the pressure reduction phase, the unconverted gasification agent together with the conversion product is brought from the deposit as product gas by means of pressure release. As a gasification agent, hydrogen is especially favorable, which in contrast to oxygen or air does not react with the obtained exothermic conversion product, methane. The product gas flowing from the deposits is converted to hydrogen and carbon monoxide above ground with steam by utilizing external heat, for example the heat from high-temperature-nuclear reactors. After suitable gas purification and conversion, hydrogen is extracted and, when heated, can serve as the new gasification agent for underground gasification. The unconverted methane in the reforming-apparatus, using the hydrogen produced, can be transported to the gas consumer.

32164 THE DESIGN OF POWER PLANTS. Boernke, F. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Essen (F. R. Germany)). Energiewirtsch. Tagesfragen; 25: No. 9/10, 472-475(Sep 1975). (In German)

9 figs.

An introduction into the basic architectural principles of the design of nuclear power plant buildings is presented. (DE)

32165 PROCESS APPLICATIONS OF NUCLEAR HEAT. Quade, R. N.; Marchetti, S. (Gen At Co, San Diego, Calif). Prepr., Div. Pet. Chem., Am. Chem. Soc.; 19: No. 3, 495-508 (Aug 1974).

The versatility of the HTGR (high-temperature gas-cooled reactor) in a wide range of process heat applications is shown – as a building block in coal liquefaction, coal gasification, and hydrogen, steel and petrochemical plants. The established base of proven HTGR technology can be extended into new areas with relatively minor design changes and applied developmental programs. Nuclear heat is now competitive with fossil fuels and in future years will be even more attractive. Extending nuclear heat into the process heat area will save up to 30% of our fossil resources for other uses. These potential benefits should be considered now in industry and governmental planning.

32166 NUCLEAR FUTURE. Esso Mag.; No. 96, 8-12(1975).

A short account is given of the development of nuclear power and of the technical and other problems that have been met. It is concluded that although work is in progress on nuclear fusion, the hope of independence from fossil fuels lies for the next few decades in the development of efficient, safe and economical nuclear fission techniques. It is stated that these are techniques in which engineers, planners, financiers and industrials are beginning to excel. (UK)

32167 NUCLEAR ENERGY RESOURCES FOR ELECTRICAL POWER GENERATION. Alder, K. F. (Australian Atomic Energy Commission, Coogee, New South Wales). At. Energy Aust.; 18: No. 1, 2-15(Jan 1975).

From conference on energy resources for electrical power generation; Melbourne (29 Oct 1974).

"Nuclear Energy Resources" is interpreted as the nuclear power systems currently available commercially and those at an advanced stage of development, together with full and associated resources required to implement largescale nuclear programs. Technical advantages and disadvantages of the established power reactor systems are reviewed, and the uranium fuel situation is outlined in terms of supply and demand, the relationship of resources to the requirements of current reactor types, and the likely future implications of the Fast Breeder Reactor (FBR). Because of its importance for the future, the problems, status, and likely time scale of the FBR are discussed in some detail. It is concluded that the most important areas for nearterm attention in Australia are the criteria and conditions that would apply to nuclear installations, and the possible development of uranium fuel cycle industries. The pattern of development of reactor and fuel cycle strategies overseas is important for uranium industry planning, and in the long term plutonium availability may be a key factor in power and energy planning. Finally, acceptance of nuclear power includes acceptance that its radioactive wastes will have to be stored on earth, and recent developments to demonstrate that this can be done safely and economically are very important in terms of longterm public attitudes. (auth)

32168 COEFFICIENTS OF SENSITIVITY OF OPTIMIZING QUANTITIES IN TECHNOLOGICAL PARAMETERS IN PROBLEMS WITH CONSTRAINTS. Kuz'min, A. M. At. Energ. (USSR); 39: No. 4, 269-271(Oct 1975). (In Russian)

A description is given of a method of calculating coefficients of sensitivity of atomic power station efficiency criteria to technological parameters when restrictions exist on various characteristics of the atomic power station. As an example, the calculation of coefficients of sensitivity for the doubling period of fast breeder reactors to such parameters as permissible temperatures and tensions in various reactor elements is presented.

32169 RADIATION PHOTOCHEMISTRY AS A POSSIBLE BASE OF EFFICIENT USE OF TWO-AIM REACTORS. Gol'danskii, V. I. At. Energ. (USSR); 39: No. 4, 243-246(Oct 1975). (In Russian)

Broad development of atomic energetics opens a very urgent problem of creation of two-aim nuclear reactors producing both electric energy and chemical products. Hazards of radioactive pollution of such products make quite dubious large-scale chemical applications of both chemonuclear synthesis and synthesis induced by mixed (n, γ)-radiation. The absence of high-temperature nuclear fuel elements prevents the efficient realization in nuclear reactors of the processes connected to the necessity of strong (up to 2000–25000° C) heating of reactants. As a result the radiation contours seem at present to be a most promising variant of two-aim use of nuclear reactors. It is shown, that the radiation-photochemical method can also be successfully applied beside the contour variant-namely, the transformation of fission fragments energy in the energy of light (possibly, even of coherent light) and then the use of produced light for realization of photochemical reactions.

32170 NATURAL CONVECTION OF A HEAT-GENERATING FLUID WITHIN CLOSED VERTICAL CYLINDERS AND SPHERES. Kee, R. J. (Sandia Labs., Livermore, CA); Landram, C. S.; Miles, J. C. J. Heat Transfer; 98: No. 1, 55-61(Feb 1976).

Steady natural convective flow fields were numerically and experimentally characterized for 0.7 Prandtl number fluids having constant, uniformly distributed, internal heat sources. The bounding isothermal walls containing the fluid were considered to be either a sphere or a cylinder of finite height. An instrumented cylinder containing radioactive tritium gas was used to demonstrate experimental and analytical agreement for local temperatures over a range of Grashof numbers. For the spherical geometry, a generalized correlation was obtained for the surface-averaged Nusselt number as a function of a modified Grashof number.

32171 NUCLEAR AND THERMONUCLEAR POWER ENGINEERING. Aleksandrov, A. P. Vestn. Akad. Nauk SSSR; No. 2, 24-31(Jan 1975). (In Russian).

For English translation see the journal Vestn. USSR Acad. Sci.

32172 NUCLEAR INDUSTRY POISED FOR BIG EXPANSION. Mod. Power Eng.; 69: No. 7, 48-49(Jul 1975).

At the Canadian Nuclear Association's 15th Annual International Conference, Prime Minister Trudeau announced that Canada will continue to develop and export nuclear reactors, under proper safeguards, to underdeveloped countries. Utilities will be required to show that they have a 15 year fuel supply for operation at 80% of capacity. Government projections indicate that Canada will require an average of four reactors a year between 1975 and 1983 reaching a peak of six in 1983, with at least one additional unit a year for export.

32173 PROCEEDINGS OF THE SEMINAR ON PROSPECTS AND FUTURE OF ATOMIC POWER GENERATION IN INDIA. Bhattacharyya, A. (Ed.). Calcutta; Institution of Engineers (1974). 80p.

From seminar on prospects and future of atomic power generation in India; Calcutta, India (12 Jan 1973).

The seminar on "Prospects and Future of Atomic Power Generation in India" held at Calcutta, India in 1973 was a valuable and timely contribution to the continuing debate on the possible solutions for obtaining more uninterrupted "power" to offset, at least to some extent, the present power crisis in India. The papers presented a variety of problems that need to be encountered and the alternative solutions that may be sought to get over the power shortage crisis which has seriously come in the way of furthering the economic and industrial progress of the country. Individual papers presented were: (1) prospect, future and present status of nuclear power generation in India, (2) a case for atomic power plant in the eastern region, (3) feasibility study of a nuclear energy center and integrated agro-industrial complex in Eastern India, (4) MHD Generation, (5) national policy for power generation, and (6) nuclear desalinisation of seawater.

32174 ENERGY SYSTEMS [PART II]. Haefele, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Indian J. Power River Val. Dev.; 24: No. 10, 295-305(Oct 1974).

Problems underlying the systems approach to the energy problem are discussed. System problems of an energy system are illustrated by considering the problems of nuclear energy. Systems analysis to solve these systems problem has (1) to identify and understand all system problems inherent in the various options for large-scale energy supply and (2) to consider embedding of energy into the atmosphere, the hydrosphere, the ecosphere and the sociosphere. The dimensions of these tasks are explained in detail. On the basis of foregoing discussion, a first order approach to the meaning of the term energy systems is given and is depicted diagrammatically. Finally, an asymptotic solution of the energy problem in its long range phase is illustrated by explaining the concept of a nuclear park which would decouple the interweaving between water, energy and the weather.

32175 ATOMIC ENERGY IN INDIA. Sci. Opin.; 3: No. 4, 5-23(May 1975).

The history of the birth and development of the Department of Atomic Energy in India, from the early forties, when it was conceived by Dr. Homi Bhabha, is traced. Starting from the first reactor Apsara, the ushering in of various activities such as the setting up of the CIRUS reactor, fabrication of fuel elements, installation of fuel reprocessing plants, production of heavy water, installation of Tarapur Atomic Power Station, etc. are described. The progress made in setting up other power projects based on natural uranium fuel and heavy water moderator, is mentioned. Fundamental and applied research carried out in the establishment in the various fields of science are highlighted. A brief assessment of the program, including all its limitations is included. Assistance received from abroad for the different projects is mentioned. An attempt is made to look into the future of the program.

32176 HANDASAT CURIM GAARINIM. (Nuclear Reactor Engineering). Yiftah, S. Israel; Michlol Publ. Co. (Sep 1974). 579p. (In Hebrew).

1 appendix of power reactors in operation, in construction or already ordered.

The book deals with the various aspects of nuclear energy with emphasis put on the engineering side. The theory and technology of nuclear reactors is discussed as well as the problems of nuclear power and of its economics. (INIS)

32177 LECTURE NOTES ON NUCLEAR POWER ENGINEERING. III. Gas Cooled Thermal Reactors, Light Water Reactors (PWR, BWR). Bombay; Indian Institute of Technology (1974). 46p.

Lecture notes are presented on gas cooled thermal reactors, PWR, and BWR type reactors. The lectures were prepared for students taking a university level course in nuclear power engineering.

32178 LECTURE NOTES ON NUCLEAR POWER ENGINEERING. IV. Heavy Water Reactors, Organic Moderated Reactors, Liquid Metal Cooled Reactors. Bombay; Indian Institute of Technology (1974). 60p.

8 refs.

Lecture notes are presented on heavy water reactors, organic moderated reactors, and liquid-metal cooled reactors. The lectures were prepared for students taking a university level course in nuclear power engineering.

32179 LECTURE NOTES ON NUCLEAR POWER ENGINEERING. V. Breeder Reactors, Containment and Safety of Reactors, Economics of Nuclear Power, Health Physics. Bombay; Indian Institue of Technology (1974). 122p.

13 refs.

Lecture notes are presented on breeder reactors, containment and safety of reactors, economics of nuclear power, and health physics aspects of nuclear power. The lectures were prepared for students taking a university level course in nuclear power engineering.

32180 LECTURE NOTES ON NUCLEAR POWER ENGINEERING. VI. Research Reactors, Radiation Detection, Radiation Shielding. Bombay; Indian Institute of Technology (1974). 87p.

14 refs.

Lecture notes are presented on research reactors, radiation detection, and radiation shielding aspects of nuclear reactors. The lectures were prepared for the students taking a university level course in nuclear power engineering.

32181 IEEE-323-1974: INDUSTRY SURVEY (CONDUCTED BY NPEC-SC2, WORKING GROUP 2.0). Survey Results. Pai, M. (United Engineers and Constructors Inc., Philadelphia). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 793-802(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

In order to determine the response to and the effectiveness of IEEE-323-1974, Subcommittee 2.0 of NPEC decided in its first meeting of 1975 to conduct an industry survey. The findings of the survey are presented.

32182 IEEE/PES NUCLEAR POWER ENGINEERING COMMITTEE (NPEC) STANDARDS DEVELOPMENT: STATUS AND OBJECTIVES. Allen, R. E. (United Engineers and Constructors Inc., Philadelphia). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 786-787(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The long term objectives and current status of the Nuclear Industry standards development effort within the scope of NPEC are discussed.

32183 ATOMIC SCIENCE AND ENGINEERING IN THE ECONOMY OF THE SOVIET UNION. Kruglov, A. K. At. Energ. (USSR); 40: No. 2, 103-116(Feb 1976). (In Russian)

The article considers achievements in the field of nuclear reactor construction and reflects changes which have made it possible to obtain relatively cheap nuclear power using fuel from uranium ores. The introduction of radioactive nuclides has led in a number of branches of industry to improved technology, automated control and improved safety engineering. Radioactive nuclides are becoming more and more widespread in medicine. Certain aspects of the application of nuclear explosions in industry and in the construction of special hydro-projects and reservoirs are considered. At a number of enterprises, by means of such explosions there have already been created subterranean caverns for the burial of concentrates from processing toxic chemical materials. An important role in the economy is played by so-called nuclear by-products. Charged-particle accelerators find application in industry and medicine.

32184 SIGNIFICANCE OF HIGH-TEMPERATURE REACTORS IN THE SCIENTIFIC AND TECHNOLOGICAL PROGRESS OF POWER ENGINEERING. Dollezhal, N. A.; Koryakin, Yu. I. At. Energ. (USSR); 40: No. 2, 133-144(Feb 1976). (In Russian)

The authors considered possible areas of application of high-temperature reactors: for more economical (than conventional types of reactors) production of electrical energy and for processes unrelated to the production of electrical energy. The latter include high-temperature technological processes in metallurgy, chemistry, coal gasification etc. Taking into account the specific nature of such processes, the authors direct attention to the idea of removing high-temperature heat from the core by means of beam heat exchange, which has a number of advantages relative to conventional convective heat exchange.

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 32370, 32374, 32384, 32385, 32387, 32389, 32394, 32398, 32401, 32411, 32414, 32419, 32425–32427, 32433, 32438, 32440, 32578, 32581, and 32583.

32185 (AED-CONF-75-541-000, pp v) PRESTRESSED-CONCRETE REACTOR PRESSURE VESSEL FOR BWR TYPE REACTORS. Huber, G. 1975. (In German).

From conference on research and development in the field of prestressed-concrete reactor pressure vessels; Berlin, F.R. Germany (13 Oct 1975).

In prestressed-concrete reactor pressure vessels. Vol. 1. Introduction: Design-oriented research and development. (Deutscher Ausschuss fuer Stahlbeton, Berlin (F.R. Germany)).

The present work deals with the calculation of the concrete pressure vessel and of the hot liner and describes the cooling system, the ceramic insulation, the leakage system, and the instrumentation of a prestressed-concrete pressure vessel for boiling-water reactors.

32186 (AED-CONF-75-541-000, pp v) COMPLETELY INTEGRATED PRESTRESSED-CONCRETE REACTOR PRESSURE VESSEL, TYPE "STAR" Neunert, B.; Jueptner, G.; Kumpf, H. 1975. (In German).

From conference on research and development in the field of prestressed-concrete reactor pressure vessels; Berlin, F.R. Germany (13 Oct 1975).

69 figs.; 3 refs. With abstract.

In prestressed-concrete reactor pressure vessels. Vol. 1. Introduction: Design-oriented research and development. (Deutscher Ausschuss fuer Stahlbeton, Berlin (F.R. Germany)).

The vessel is suitable for the connection to all primary circuit systems consisting of a main vessel and a number of satellite vessels around and connected to it, i.e., for LWR, HTR and process reactors. It must be made clear, however, that the PWR in particular with its components does not appear to be suited for the optimum incorporation in a prestressed-concrete pressure vessel system, no matter what kind. There are clear concepts about modifications which, however, require considerable development expenditure.

32187 (AED-CONF-75-541-000, pp v) THE HOT LINER AS COMPONENT OF THE HEAT PROTECTION SYSTEM FOR PRESTRESSED-CONCRETE PRESSURE VESSELS. Spandick, W. 1975. (In German).

From conference on research and development in the field of prestressed-concrete reactor pressure vessels; Berlin, F.R. Germany (13 Oct 1975).

9 figs. With abstract.

In prestressed-concrete reactor pressure vessels. Vol. 1. Introduction: Design-oriented research and development. (Deutscher Ausschuss fuer Stahlbeton, Berlin (F.R. Germany)).

Aspects of safety and fabrication independence have lead to the development of the prestressed-concrete pressure vessel for light-water reactors, in particular boiling-water reactors. Included in this development is the heat protection system with the hot liner. Furthermore, the limitations of the usefulness of this system are given in order to also be able to check the applicability in prestressed-concrete pressure vessels of high-temperature reactors.

32188 (EUR-5257) EURCYL. A Program to Generate Finite Element Meshes for Pressure Vessel Nozzles. De Windt, P.; Reynen, J. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Dec 1974. 38p. INIS.

EURCYL is a program dealing with the automatic generation of finite element meshes for pressure vessel nozzles, using isoparametric elements with 8, 20 or 32 nodes. Options exist to generate BWR nozzles as well as PWR nozzles.

32189 (NEDO-20948) LICENSING TOPICAL REPORT BWR/6 FUEL DESIGN. Rogers, B. N.; Holtzclaw, K. W.; Rawlings, J. C.; Williams, R. D.; Scatena, G. J. (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). Dec 1975. vp. General Electric Co., San Jose, CA.

The BWR/6 8 x 8 fuel design has been detailed to incorporate changes which provide improvements in fuel standardization and implement improvements from operating experience feedback. In a further effort to standardize, the Licensing Topical Report presented has been prepared in the format of GESSAR and Safety Analysis Reports. The portions of a Safety Analysis Report which are significantly affected by the changes in the 8 x 8 design, as presented in GESSAR, have been written to provide a licensing package which can be inserted into a Safety Analysis Report by amendment. This standard write-up will hopefully shorten the time required to generate any specific plant submittal and the time required to review and approve a specific submittal. The sections of the report are numbered in accordance with the current GESSAR numbering. The figures are numbered sequentially by section and are not intended to correspond to current GESSAR figures numbers for similar figures.

32190 (NUREG-0032) FUEL PERFORMANCE OF LICENSED NUCLEAR POWER PLANTS THROUGH 1974. Bobe, P. E. (Nu-

clear Regulatory Commission, Washington, D. C. (USA)). Jan 1976. vp. Dep. NTIS $5.00.

General aspects of fuel element design and specific design data for typical Pressurized and Boiling Water Reactors are presented. Based on a literature search, failure modes and specific failures incurred through December 31, 1974 are described, together with a discussion of those problems which have had a significant impact upon plant operation. The relationship between fuel element failures and the resultant coolant activity/radioactive gaseous effluents upon radiation exposure, plant availability and capacity factors, economic impact, and waste management, are discussed. An assessment was made regarding the generation, availability, and use of fuel performance data.

32191 (PPSE-4-2(Vol.3)) PROJECTED ELECTRIC POWER DEMANDS FOR THE POTOMAC ELECTRIC POWER COMPANY. Wilson, J. W. (Maryland Dept. of State Planning, Baltimore (USA)). Jul 1975. 160p. Maryland Dept. of State Planning, Baltimore.

Included are chapters on the background of the Potomac Electric Power Company, forecasting future power demand, demand modeling, accuracy of market predictions, and total power system requirements. (DG)

32192 NUCLEAR REACTOR PRESSURE VESSELS OF PRESTRESSED CONCRETE. Goffin, H. Beton. Herstellung. Verwend.; 24: No. 10, 378-384(Oct 1974). (In German with English Abstract).

The results of basic research presented show how to build prestressed concrete reactor pressure vessels for boiling water reactors, pressurized water reactors, and gas-cooled-high-temperature reactors economically considering all requirements of technical safety.

32193 COMMERCIAL NUCLEAR POWER PLANTS IN OPERATION. Pt. 2. Operating Experience with, and Reliability of Boiling Water Reactors. Baumgartl, B. J. (Kraftwerk Union A. G., Offenbach (F. R. Germany)). Kerntechnik; 17: No. 9/10, 415-418(Sep 1975). (In English, German).

3 figs. Pre-report on the subject of technical meeting No. 4.

The gross electric power generation since January 1973 of the nuclear power stations at Gundremmingen A, Wuergassen, and Lingen is depicted in operation diagrams. The reasons for shutdowns are summarized. (DE)

32194 INVESTIGATION OF SPACE- AND TIME-DEPENDENT PROCESSES IN THE CORE OF A BOILING WATER REACTOR WITH A MODULAR COMPUTER MODEL. Schreiber, G. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Atomkernenergie; 26: No. 3, 169-173(1975). (In German)

11 figs.; 4 refs.

A modular, one-dimensional space-dependent model for determination of the transient behavior in the core of a boiling water reactor was developed for use with an available program system for reactor calculations. It consists of the neutron-kinetic module DYNMOD, the thermohydraulic modules DYNSID 1-3 and the module STATEMP for investigation of the stationary initial values. The coupling between the thermohydraulic and the neutron-kinetic processes is ensured by direct manipulation of the effective cross sections. Two experiments obtained during the testing of the nuclear plant in Wuergassen were computed with this model to gain information on its capability. Satisfactory results were obtained and the influence of space dependence could be studied using the model. (DE)

32195 ELECTRICAL SUPPLY AND CONTROLS FOR INDUCED-DRAFT COOLING TOWERS AT BROWNS FERRY NUCLEAR PLANT. Mock, C. H.; Boehms, J. H. (Tennessee Valley Authority, Knoxville). IEEE Trans. Power Appar. Syst.; PAS-94: No. 5, 1742-1754(1975).

From IEEE PES winter meeting; New York, NY, USA (26 Jan 1975).

Design considerations are given for selection of electrical features as required for addition of mechanical-draft-type cooling towers at an existing multiunit nuclear generating station. Environmental and nuclear safety problems were solved economically by use of enclosed 161-kV power connections, oil-filled transformers, supervisory-type control, and unique schemes for redundancy to minimize need for Class 1E construction.

32196 DYNAMIC LOAD AND STRUCTURAL BEHAVIOR OF REACTOR SAFETY CONTAINMENTS WITH PRESSURE SYSTEMS. Mueller, R. A.; Schlechtendahl, E. G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). KFK Nachr.; 7: No. 3, 12-21(1975). (In German)

Following a description of the design and mode of operation of pressure suppression systems, the test programme carried out at Marviken and Brunsbuettel is described, and experience with the calculation of the real containment structure of a pressure suppression system is reported on. (DE)

32197 STANDARDIZING THE WATER CONDITIONS FOR THE REACTORS OF SINGLE-LOOP NUCLEAR POWER STATIONS. Margulova, T. Kh.; Martynova, O. I.; Al'tshuller, M. A. Therm. Eng. (USSR) (Engl. Transl.); 22: No. 1, 106-108(Jan 1975).

Translated from Teploenergetika; 22: No. 1, 84-86(Jan 1975).

"Standardizing" the water conditions of reactors of single-loop nuclear power stations is, above all, connected with the reliability of their operation. The main "standardized" characteristics are: chlorine ion (to avoid stress corrosion cracking of 18/8 stainless steel), silica, hardness and iron oxide content (to avoid deposits on the fuel elements). These are taken into consideration when standardizing the water conditions and calculating the amount of reactor water to be treated under the conditions usually adopted for such stations of "noncorrected" water conditions. (auth)

32198 ELECTRIC PUMP SETS IN NUCLEAR REACTORS. Ruyant, F. Rev. Jeumont-Schneider; 16: 3-16(Dec 1973). (In French)

The role of water pumps in primary coolant circuits is discussed. The totally leakproof canned-motor pumps are discussed and the reasons for their evolution towards controlled-leakage pumps are stated. The design and technology of shaft-seal pumps employed in modern high-output nuclear power plants are described and the characteristics of their major components, e.g., hydraulic section, sealing system, drive motor, thrust bearing, and flywheel are examined. (auth)

32199 METHOD FOR ERECTING AND OPERATING AT LEAST TWO NUCLEAR REACTORS. Kollmar, W.; Maerkl, H.; Thieme, K. (to Siemens Aktiengesellschaft). US Patent 3,928,128. 23 Dec 1975. Priority Date 26 Jul 1972, German, Federal Republic of (F. R. Germany). 4p.

The invention described concerns nuclear reactors with replaceable fuel elements. According to the invention, parts of the reactor core burned up in a first nuclear reactor are used for the first core of a second nuclear reactor. This permits considerable savings, particularly in pressurized-water reactors. (Official Gazette)

32200 TRANSPORT OF RADIOACTIVE CORROSION PRODUCTS IN HIGH-TEMPERATURE WATER. II. The Activation of Isothermal Steel Surfaces. Lister, D. H. (Chalk River Nuclear Labs., Ont.). Nucl. Sci. Eng.; 59: No. 4, 406-426(Apr 1976).

A mathematical model to describe the contamination of steel surfaces by ^{60}Co in high-temperature water is developed. The model assumes that ^{60}Co is incorporated into the growing oxide film on the steel, so that the contamination rate is governed by corrosion kinetics. Release to inactive coolant is controlled by solid-state diffusion and is consequently very slow. Diffusion processes for both release and activation are modeled in terms of a diffusion parameter that is characteristic of the surface oxide. The model is tested with data from recirculating and once-through loops, and good fits are obtained if either parabolic or logarithmic corrosion kinetics are assumed, although logarithmic kinetics are somewhat better.

32201 ARRANGEMENT FOR INSPECTION OF NUCLEAR FUEL CAN RUPTURES. Tschirne, G. German(GDR) Patent 111,487/D/. 12 Feb 1975. 9p. (In German).

The device concerns an arrangement for inspection of can ruptures in nuclear fuel elements of LWR's by means of the detection of fission products according to the dry-sipping method.

32202 THABNA — A COMPUTER PROGRAM FOR THE THERMAL HYDRAULIC ANALYSIS OF BOILING NUCLEAR ASSEMBLIES. Venkatraj, V.; Anand, A. K.; Saha, D. (Bhabha Atomic Research Centre, Bombay (India). Reactor Engineering Div.). pp 27-31 of Proceedings of the Second National Heat and Mass Transfer Conference, Held at Kanpur, 13-15 December 1973. Section C. Kanpur; Indian Institute of Technology (1974).

From 2nd national heat and mass transfer conference; Kanpur, India (13 Dec 1973).

THABNA, a digital computer (CDC-3600) program developed for the Thermal Hydraulic Analysis of Boiling Nuclear Assemblies, is described. This program can be used for calculating the flow distribution, pressure drop, critical heat flux and minimum critical heat flux ratio in the core of a boiling water reactor. The calculation procedure and the equations used are worked out in detail. (auth)

32203 CHEMICAL CONSIDERATION IN NUCLEAR POWER PLANTS. Heitmann, H. G. (Kraftwerk Union AG, Erlangen, Ger.). Chem.-Ing.-Tech.; 48: No. 2, 124-129(Feb 1976). (In German).

Chemical questions occurring in nuclear power plants are discussed. In particular, these concern chemical and process en-

gineering facilities which are adapted especially for implementation under radioactive conditions. Questions relating to the environment are also considered.

32204 PLATE-LIKE NUCLEAR FUEL ELEMENT AND THE PROCESS FOR MANUFACTURING SAME. Bergougnoux, R.; Delafosse, J. (to CEA, 75 – Paris (France)). French Patent 2,236,250/A/. 6 Jul 1973. 12p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

This element is characterized in that the fuel core is constituted by a plurality of juxtaposed small plates of ceramic fuel material each of which is coated with a thin metal sheel, said small plates being aligned in several rows so as to cover the whole area of the fuel plate. This can be applied to light water nuclear reactors. (FR)

32205 CONDENSER FOR VERY HIGH POWER STEAM TURBINES. Bargey, R. (to Compagnie Electro-Mecanique (CEM), 75 – Paris (France)). French Patent 2,237,491/D/. 12 Jul 1973. 14p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention relates to a condenser for very high power steam turbines under the masonry-block supporting the low-pressure stages of the turbine, that condenser comprises two horizontal aligned water-tube bundles passing through the steam-exhaust sleeves of the low-pressure stages, on both sides of a common inlet water box. The invention can be applied in particular to the 1000-2000 MW turbines of light water nuclear power stations. (FR)

32206 ORGANIZATION AND DEVELOPMENT OF THE INSTRUMENT DEPARTMENT AT EDWIN I. HATCH NUCLEAR PLANT. Greene, T. V. Jr. (Georgia Power Co., Baxley). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 765-769(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Developing an effective instrument department is an important part of a safe and reliable nuclear power plant. Plant Edwin I. Hatch, the first nuclear generating station in the Georgia Power system, presented problems unique in the Company for establishment and operation of its instrument shop. The initial organization of the shop was based on the Company's fossil power plants with expected man power estimated from the previous nuclear startups of other utilities. The construction testing program was mainly performed by the Production Department requiring temporary technical services to meet the work loads prior to and during initial fuel loading of the reactor. The testing requirements listed in the Plant Technical Specifications had grown from those of earlier nuclear plants taking more personnel to operate the surveillance program. Engineering changes in the shop necessitated restructuring the organization with the most experienced technicians providing direct supervision. Implementation of a comprehensive testing program for the plant instrumentation required the use of a computer and an extensive training program to provide the efficiency needed to manage it. The problems encountered during the development of the instrument department and the methods used to resolve them are described.

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 30068, 32188, 32190, 32198–32201, 32203–32205, 32371, 32373, 32374, 32380, 32384, 32385, 32390–32392, 32394, 32411, 32413, 32414, 32422, 32425–32427, 32431, 32433, 32438, 32439, 32549, 32550, 32579, 32580, and 32582.

32207 (AED-CONF-75-541-000, pp v) PRESTRESSED CONCRETE REACTOR PRESSURE VESSEL WITH HOT LINER FOR PWR TYPE REACTORS. Reference Design. Jungmann, A.; Kopp, H.; Gangl, M.; Nemet, J.; Nesitka, A.; Walluschek, W.; Mutzl, J. 1975. (In German).

From conference on research and development in the field of prestressed-concrete reactor pressure vessels; Berlin, F.R. Germany (13 Oct 1975).

10 figs.; 11 refs. With abstract.

In prestressed-concrete reactor pressure vessels. Vol. 1. Introduction: Design-oriented research and development. (Deutscher Ausschuss fuer Stahlbeton, Berlin (F.R. Germany)).

Prestressed-concrete pressure vessels are being used at present for gas-cooled reactors. They are in the planning stage or under construction for boiling-water reactors and high-temperature reactors. The use of a prestressed-concrete pressure vessel for PWR type reactors is, however, something new. Kraftwerk Union, Erlangen, developed such a pressure vessel for pressurized-water reactors as a reference design according to the concept of the Reaktorbau Forschungs- und Baugesellschaft (RFB)/Austria. The tasks of the reference design deal mainly with the technical, constructive realizability with limiting conditions of a 1300 MW(e) reactor plant.

32208 (CEA-CONF-3141) SOLUBILIZATION OF DEPOSITS IN REACTOR CIRCUITS. Beslu, P.; Frejaville, G.; Lalet, A.; Micaux, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). Jun 1975. 34p. (In French). INIS.

From seminar on decontamination of nuclear plants; Columbus, USA (7 May 1975).

The mechanisms of deposit solubilization in the circuits of PWR reactors were studied. The experimental results obtained during partial cooling of the primary water in a loop of the Ardennes Nuclear Station Reactor are presented, together with the activity variation of the primary fluid when reactors are shut down for reloading (CNA and reactor Beznau II). A theoretical model was developed (Pothy Code) to describe these phenomena quantitatively, and compared with the experimental results in order to estimate its validity and its limits. An attempt was made to use these solubilization phenomena for the decontamination of a loop at the Ardennes Nuclear Station. (FR)

32209 (EUR-5227) ARDENNES NUCLEAR POWER PLANT. Annual Report, 1973. (Commission of the European Communities, Luxembourg; Societe d'Energie Nucleaire Franco-Belge des Ardennes, 08 - Chooz-lez-Givet (France)). Dec 1974. 46p. (In French). INIS.

The SENA nuclear power plant continued to operate, as before, at authorized rated power, namely 905 MW(t) during the first half year and 950 MW(t) during the second half year. Net energy production: 3028 GNH; hours phased to the line: 7534H; availability factor: 84%; utilization factor: 84%; total shutdowns: 19; Number of scrams: 10; cost per Kwn: 4.35 French centimes. Overall, the plant is performing very satisfactorily. Over the last three years net production has been 5900 GNh, corresponding to an average utilization factor of 83%.

32210 (NRC-TR-1) BEHAVIOR AND PHYSICO-CHEMICAL STATE OF FISSION PRODUCTS IN FUEL ELEMENTS FOR PRESSURIZED WATER REACTORS. Bazin, J.; Jouan, J.; Vignesoult, N. Translated from Bull. Inf. Sci. Tech. (Paris); No. 196, 55-71 (1974). 23p. Dep. NTIS $3.50.

The behavior of fission products in fuel pins for pressurized water reactors (PWRs) was investigated by means of the analytical tools available in the hot laboratory. The study was run on elements from experimental irradiations effected under conditions similar to those prevalent in commercial power reactors or under very different conditions, so as to test the fuel up to its utilization limits. Fission products present in fuel elements were identified and their locations pinpointed. The several compounds and alloys they form with each other or with the fuel were determined, particularly with respect to the oxide-cladding reaction, in an attempt to define the conditions under which this reaction occurs, as a function of irradiation conditions.

32211 PERMANENT CONTROL OF THE pH VALUE AND THE CONTENT OF CHLORINE IONS IN THE COOLING WATER OF NUCLEAR REACTORS. Moskvin, L. I.; Krasnoperov, V. M.; Fokina, R. G.; Vilkin, N. Ya. Arch. Energiewirtsch.; 29: No. 9, 886-891(Sep 1975). (In German)

5 figs.; 8 refs. Also published in At. Ehnerg. v. 38 (Mar 1975) p. 143-145.

A potentiometer cell is described through which the cooling water to be controlled flows in two tubes. One of these tubes contains ion-exchanging material which exchanges Cl^- for OH^- ions. From the potential difference between two essentially identical glass reference electrodes, the pH value—and thus the content of Cl^- ions in the cooling water—is derived. There is a linear dependence between the potential difference and the pH value in the range $4 < pH < 11$. (DE)

32212 PLANNING, ERECTING AND START-UP OF THE 1,200 MW NUCLEAR POWER PLANT AT BIBLIS. Eitz, A. W. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Essen (F. R. Germany). Abt. Kraftwerke). VGB Kraftwerkstech.; 55: No. 10, 646-654(Oct 1975). (In German)

13 figs.

At present nuclear power plants with tested light-water reactors give the only technically and economically reliable basis to fulfill this program. Nuclear power plants of the Biblis type occupy the greatest share by far. They represent about 70% of the nuclear power plant output in operation in the beginning of the eighties alone. The results of the planning, erecting and start-up and the up-to-present operation of Biblis A are presented. (DE)

32213 COMMERCIAL NUCLEAR POWER PLANTS IN OPERATION. Pt. 1. Operating Experience with, and Reliability of Pressurized Water Reactors. Gruener, W. (Kraftwerk Union A. G., Erlangen (F. R. Germany)). Kerntechnik; 17: No. 9/10, 411-414(Sep 1975). (In English, German).

A brief outline is given of the present state of development of pressurized-water reactors of the present generation in the FRG. Comparing with the situation abroad, great efforts are made to forward the problems of standardization, fuel cycle, and safety. (DE)

32214 SPECTRAL CHARACTERISTICS OF THE BACKGROUND NOISE IN THE PRIMARY LOOP OF AN ATOMIC GENERATING PLANT. Adamenkov, K. A.; Gorbachev, V. I.; Zakharov, Yu. V.; Kruglov, V. P.; Paraev, S. A.; Reznikov, Yu. A.; Khasyanov, R. F. Sov. At. Energy (Engl. Transl.); 38: No. 6, 543-544(Jun 1975).

Translated from At. Energ.; 38: No. 6, 425-426(Jun 1975).

Piezoelectric transducers were used to study the spectral characteristics of background noise in the primary circuit of the Novovoronezh-3 Reactor in the frequency range from 0.2 to 2.5 MHz with the reactor operating at full capacity. It was found that frequencies above 500 kHz were relatively devoid of background noise.

32215 FRANCO-BELGIAN NUCLEAR POWER STATION AT TIHANGE (BELGIUM). de Gelas, C. (Besson-Saint-Quentinoise, Acier Stahl. Steel; 39: No. 5, 214-219(May 1974).

Design data for construction of buildings for an 870 MW nuclear power plant are presented. The plant is of the pressurized water type reactor. Details of the portal frame of a steel trussed roof are given.

32216 PROBLEM OF RELIABILITY OF THE OPERATION OF STEAM GENERATORS OF NUCLEAR POWER PLANTS WITH WATER-COOLED REACTORS. Styrikovich, M. A.; Margulova, T. Kh. (Acad of Sci of the USSR). Teploenergetika (Moscow); No. 9, 55-57(Sep 1974). (In Russian).

The problem of leakage of the heat carrier into the second loop in steam generators of LWRs and its prevention is considered and the solution of this problem by Westinghouse is discussed. In particular, the leakage due to damage of tubes in the vicinity of tube sheets in vertical steam generators has occurred in the USSR. Problems posed by iron oxide slurry are discussed. To prevent formation of iron oxide slurry, continuous dosage of chelating agents is recommended. Joint design and water treatment approach to solve the problem is urged.

32217 ELECTRICAL EQUIPMENT OF RINGHALS 2 NUCLEAR POWER PLANT IN SWEDEN. Ofner, G.; Zawrzel, E.; Candel, J. Brown Boveri Rev.; 62: 400-411(Sep 1975).

The 860 MW Ringhals 2 nuclear power plant commenced operation in 1974. Brown Boveri designed and supplied some major items of electrical equipment for this plant, the main features of which are outlined.

32218 DAS KERNKRAFTWERK BIBLIS DES RWE. (The RWE Nuclear Power Station at Biblis). Graefen, E. (ed.); Mandel, H.; Dieterich, L.; Hippel, W.; Tochtrop, F.; Wolf, M.; Berg, D.; Koch, W.; Heining, U.; Rast, H. E. Musteranlagen der Energiewirtschaft. Graefelfing, F. R. Germany; Energiewirtschaft und Technik Verl. Ges. (1975). 112p. (In German)

The authors give a survey of the construction of Biblis-1 and -2. The various reactor components and design data are described. The problems met during construction are described, and radiation monitoring and radiation protection on the site are dealt with. (DE)

32219 DETERMINATION OF THE FRACTION OF FISSIONED PLUTONIUM NUCLEI DURING BURNUP OF LOW-GRADE FUEL. Zykov, K. I.; Miller, O. A. At. Energ. (USSR); 39: No. 4, 265-268 (Oct 1975). (In Russian)

A means determining the fraction on fissioned plutonium-239 nuclei in total fuel burnup by measuring the ratio of ruthenium-106 and cesium-137 concentrations is proposed. The question of accounting for burned up and decayed nuclei of fission products during irradiation is discussed and a formula presented to determine corresponding corrections. The fraction of decayed plutonium-239 nuclei for the fuel of a water-moderated water-cooled reactor of the Novo-Voronezh type, using an average calculated burnup of 14.6 kg/ton, has been determined. It is concluded that the change of neutron field spectrum in the fuel cassette along its height and from one fuel element to another affects significantly the burnup (and hence accumulation of plutonium-239) in water-moderated water-cooled reactors using low-grade nuclear fuel.

32220 BIOLOGICAL SHIELD FOR A NUCLEAR REACTOR. Schabert, H. P.; Ropers, J.; Strickroth, E. (to Siemens Aktiengesellschaft). US Patent 3,928,133. 23 Dec 1975. Priority Date 26 May 1972, German, Federal Republic of (F. R. Germany). 6p.

The invention described discloses a biological shield for a nuclear reactor such as a pressurized-water reactor and the like. The biological shield surrounds the reactor pressure vessel and is made of concrete. The shield includes two concentric shield parts and a cooling medium is conducted through a gap conjointly defined by the shield parts.

32221 REACTOR-PHYSICAL AND TECHNOLOGICAL CHARACTERISTICS OF CORE LAYOUTS FOR PRESSURIZED WATER REACTORS AND FAST BREEDERS. Pt. 1. Kozyk, J.; Zorn, K. (ORGREB–Institut fuer Kraftwerke, Berling (German Democratic Republic). Betriebsteil). Kernenergie; 18: No. 8, 233-237(1975). (In German).

The status and trends of the development of pressurized water reactors and fast breeders are reviewed in conjunction with working out a data bank which covers the reactor physical and technological characteristics of those reactors. The review consists of two parts. The first part deals with pressurized water reactors. It includes a first comparative evaluation of the core characteristics integrating the main technological and economic characteristics of the power station as a whole. As concerns the selection of the reactors to be considered, the attempt was made, on the one hand, to comprehend recent nuclear power stations and projects altogether, and on the other hand, to watch definite lines of development during a longer period in order to derive information on further development of these types of reactors.

32222 TRENDS IN THE DESIGN OF PRESSURIZED WATER REACTOR STEAM GENERATORS. Krizek, V. (Prvni Brnenska Strojirna (Czechoslovakia). Odbor Nuklearni Techniky). Kernenergie; 18: No. 8, 240-248(1975). (In German).

The main directions of development of steam generator concepts are stated. Individual types of horizontal and vertical saturated steam generators are compared with each other. Further development of drum-type steam generators with forced circulation and the possibilities of constructing them by a modular technique are discussed. The project solution is given, and the problems associated with engineering, transport, mounting, and operation of the individual types are indicated; with this, especially the needs of the near future prospect in Czechoslovakia are taken into account. Furthermore, problems involving performance of experiments and manufacture of steam generators are discussed.

32223 DESIGN OF A NUCLEAR POWER PLANT WITH 1000 MWt WWER TYPE REACTORS. Berkovich, V. M.; Kaloshin, Yu. P.; Tatarnikov, V. P.; Shenderovich, A. S. Teploenergetika (Moscow); No. 4, 18-22(Apr 1974). (In Russian).

For English translation see the journal Therm. Eng.

32224 RSA JOINS 20-NATION NUCLEAR "CLUB". To the Point; 7-9(4 Jul 1975).

Nuclear energy and several aspects connected with it are discussed. South Africa's position in the world nuclear situation is emphasized with specific mention of the uranium enrichment process and the proposed nuclear power station at Koeberg.

32225 TECHNICAL-ECONOMIC CHARACTERISTICS OF THE NUCLEAR POWER PLANT. pp 289-303 of Operation of Novo Voronezh Nuclear Power Plant Reactors. Prague; SNTL-Nakladatelstvi Technicke Literatury (1974). (In Czech).

Translated from "Ehkspluatatsiya reaktornykh ustanovok Novovoronezhskoj AES," Moscow, Atomizdat, 1972.

(Ceskoslovenska Komise pro Atomovou Energii, Prague).

An analysis is presented of the respective technical-economic indicators of the Novo Voronezh nuclear power plant operation (mainly of power generation cost) and possible improvements are discussed. (INIS)

32226 BASIC CHARACTERISTICS OF LIGHT-WATER POWER REACTORS. pp 127-170 of Operation of Novo Voronezh Nuclear Power Plant Reactors. Prague; SNTL – Nakladatelstvi Technicke Literatury (1974). (In Czech).

Translated from "Ehkspluatatsiya reaktornykh ustanovok Novovoronezhskoj AES," Moscow, Atomizdat, 1972. (Ceskoslovenska Komise pro Atomovou Energii, Prague).

A description is presented of the principles of the ROR and MGR computer codes for use in computing the physics and neutron characteristics of WWER type reactor lattices containing the low-enriched fuel and the light-water moderator. The effect is discussed of the distribution of thermal energy release in the core volume on reactor output increase. The cartograms and the characteristics are given for the first six fuel charges of the WWER 210 reactor. The supplies of and the changes in reactivity of the first fuel campaign of the WWER 210 reactor are described and the efficiency of scram, regulating, and shim assemblies is discussed. (INIS)

32227 REACTOR VESSEL, UPPER SECTION, AND REACTOR INTERNALS. pp 33-56 of Operation of Novo Voronezh Nuclear

Power Plant Reactors. Prague; SNTL – Nakladatelstvi Technicke Literatury (1974). (In Czech).

Translated from "Ehkspluatatsiya reaktornykh ustanovok Novovoronezhskoj AES," Moscow, Atomizdat, 1972. (Ceskoslovenska Komise pro Atomovou Energii, Prague).

The basic parameters and the concept are described of the reactor pressure vessels, the upper section containing the control rod drives, and the reactor internals (reactor shaft with bottom, thermal shield, removal basket, supports of fuel and regulating assemblies, etc.). (INIS)

32228 REACTOR CORE. pp 13-32 of Operation of Novo Voronezh Nuclear Power Plant Reactors. Prague; SNTL-Nakkadatekstvu Technicke Literatury (1974). (In Czech).

Translated from "Ehkspluatatsiya reaktornykh ustanovok Novovoronezhskoj AES," Moscow, Atomizdat, 1972. (Ceskoslovenska Komise pro Atomovou Energii, Prague).

The technical specifications and basic parameters are given of the WWER type light-water reactors. Described are the characteristics of the fuel, fuel elements and assemblies, the specifications thereof and materials used. (INIS).

32229 CIRCULATION LOOPS OF PRIMARY COOLANT CIRCUIT. pp 57-81 of Operation of Novo Voronezh Nuclear Power Plant Reactors. Prague; SNTL – Nakladatelstvi Technicke Literatury (1974). (In Czech).

Translated from "Ehkspluatatsiya reaktornykh ustanovok Novovoronezhskoj AES," Moscow, Atomizdat, 1972. (Ceskoslovenska Komise pro Atomovou Energii, Prague).

The technical specification and the parameters are given of the main circulation pumps, steam generators, pressurizers, fittings and of the main circulation piping of the Novo Voronezh nuclear power plant primary circuits. The specifications pertaining to the quality of water for the steam generators described are listed. (INIS)

32230 SPECIAL EQUIPMENT OF WATER PURIFYING CIRCUITS. pp 82-91 of Operation of Novo Voronezh Nuclear Power Plant Reactors. Prague; SNTL – Nakladatelstvi Technicke Literatury (1974). (In Czech).

Translated from "Ehkspluatatsiya reaktornykh ustanovok Novovoronezhskoj AES," Moscow, Atomizdat, 1972. (Ceskoslovenska Komise pro Atomovou Energii, Prague).

Special equipment, such as evaporators and ion-exchange filters for purifying water in all nuclear power plant circuits are described. (INIS)

32231 NUCLEAR POWER PLANT FLOW CHARTS. pp 92-126 of Operation of Novo Voronezh Nuclear Power Plant Reactors. Prague; SNTL – Nakladatelstvi Technicke Literatury (1974). (In Czech).

Translated from "Ehkspluatatsiya reaktornykh ustanovok Novovoronezhskoj AES," Moscow, Atomizdat, 1972. (Ceskoslovenska Komise pro Atomovou Energii, Prague).

The technical specifications and flow charts are given of the primary coolant circuit, of the recirculation and replenishment system for the primary coolant circuit, of the secondary coolant circuit, of the nuclear power plant process water supply, of the intercooling circuit, of the equipment for special purification of waste and gases, and of the ventilation system of the Novo Voronezh nuclear power plant. (INIS)

32232 INSPECTION OF FUEL ELEMENT CONDITIONS. pp 171-188 of Operation of Novo Voronezh Nuclear Power Plant Reactors. Prague; SNTL – Nakladatelstvi Technicke Literatury (1974). (In Czech).

Translated from "Ehkspluatatsiya reaktornykh ustanovok Novovoronezhskoj AES," Moscow, Atomizdat, 1972. (Ceskoslovenska Komise pro Atomovou Energii, Prague).

The operating temperature regime and the thermodynamic properties of the fuel are described. The methods are reported of determining the degree of tightness of fuel element canning as are the results of investigation of spent assemblies in a hot cell. (INIS)

32233 OPERATING REGIME OF THE NUCLEAR POWER PLANT. pp 229-266 of Operation of Novo Voronezh Nuclear Power Plant Reactors. Prague; SNTL – Nakladatelstvi Technicke Literatury (1974). (In Czech).

Translated from "Ehkspluatatsiys reaktornykh ustanovok Novovoronezhskoj AES," Moscow, Atomizdat, 1972. (Ceskoslovenska Komise pro Atomovou Energii, Prague).

The start-up of the first and the second units of the Novo Voronezh nuclear power plant is described as well as their operating regime following the connection to the grid. The requirements for the quality of water for the primary cooling circuits of the WWER type reactors are listed and the chemical regime of water is described. The "wet" refuelling is described and the basic parameters of the charging machines are given. (INIS)

32234 INSPECTION AND REPAIRS OF REACTOR COMPONENTS. pp 267-288 of Operation of Novo Voronezh Nuclear Power Plant reactors. Prague; SNTL – Nakladatelstvi Technicke Literatury (1974). (In Czech).

Translated from "Ehkspluatatsiya reaktornykh ustanovok Novovoronezhskoj AES," Moscow, Atomizdat, 1972. (Ceskoslovenska Komise pro Atomovou Energii, Prague).

The decontamination regime applied in periodic inspections and repairs is described and materials, such as reactor equipment and piping, accounted for are reported. The decontamination solutions employed are listed as are their efficiency and effects on the structural materials used. (INIS)

32235 METHOD AND DEVICE FOR PROTECTING A NUCLEAR REACTOR FUEL ASSEMBLY. Ringot, C. (to CEA, 75 – Paris (France)). French Patent 2,235,464/A/. 28 Jun 1973. 11p. (In French).

Available from Institut National de la Proptiete Industrielle, Paris (France).

Description is given of a static device adapted to puncture a fuel element, should the latter be abnormally swollen. This device is characterized in that the rigid structure is constituted by a plurality of parallel grids defining evenly distributed orifices through which are inserted the fuel elements each of said orifices being provided with at least one chisel-like protrusion designed for penetrating into the fuel element cladding whenever the diameter of the latter exceeds a given amount. This can be applied to nuclear reactors of the PWR type. (FR)

32236 METHOD FOR STORING UP THERMAL ENERGY. Bonnin, J. (to Electricite de France, 75 – Paris). French Patent 2,239,160/F/. 26 Jul 1973. 7p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention relates to a method for storing up thermal energy, in particular in pressurized water nuclear power stations, through heating storage water accumulated under pressure in a tank, according to the main patent. The method is characterized by the step of storing pressurized hot water within a water sheet which is located deep enough for exerting a pressure sufficient for maintaining the stored water in the liquid state. That method affords a very economical storage capacity. (FR)

32237 METHOD AND DEVICE FOR SAMPLING AND SEPARATING LIQUID AND GASEOUS PHASES. Bouquet, P.; Friconneau, C. (to CEA, 75 – Paris (France)). French Patent 2,235,724/A/. 2 Jul 1973. 10p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The present invention relates to a method for sampling and separating liquid and gaseous phases of a volume of liquid originating from a pressurized liquid circuit at room temperature, characterized in that it comprises the steps of isolating the volume of pressurized liquid from said circuit in a first tank which is caused to communicate with a second tank, in order to de-pressurize the water contained in said first tank, and causing a sweeping inert gas to bubble in the liquids of both tanks in order to drive the gases dissolved in the liquid into a third tank. This can be applied to the sampling of the liquid and gas phases contained in pressurized liquids in particular the liquids provided by the circuits of water cooled nuclear reactors. (FR)

32238 INSTRUMENT, CONTROL, AND ELECTRICAL OPERATING EXPERIENCES: FORT CALHOUN STATION UNIT NO. 1. Nagl, J. M. (Omaha Public Power District). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 779-781 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Fort Calhoun Station Unit No. 1 is Omaha Public Power District's first nuclear generating facility. A second unit (1150 MWe) is now in the design stage with operation scheduled for 1983. Unit No. 1 is a 480 MWe PWR located twenty miles north of Omaha, Nebraska, on the Missouri River. Instrumentation problems occurring in startup and testing are described.

32239 FEDERAL INTERAGENCY RADIOLOGICAL EMERGENCY RESPONSE PLANNING PROGRAM IN SUPPORT OF FIXED NUCLEAR FACILITIES. Collins, H. E. (Nuclear Regulatory Commission, Washington, DC). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 804-807 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The existing Federal Interagency Radiological Emergency Response Planning Program in Support of Fixed Nuclear Facilities is discussed. The program is designed to assist States and local governments in developing and improving their Radiological Emergency Response Plans that are supportive of nuclear facility emergency plans required by regulations of the Nuclear Regulatory Commission.

32240 ZION STARTUP AND OPERATING EXPERIENCE. Wagner, G. P. (Commonwealth Edison Co., Zion, IL). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 758-764(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Several significant events related to the startup and initial operation of Zion Generating Station are reported. Among the events described are a diode installation that resulted in failure of one redundant Engineered Safeguard logic and a wiring reversal that negated one safeguards function. A series of electrolytic capacitor failures are presented and the NSSS vendor's proposed corrective action is supplied. Three major electrical failures are described; these include a reactor coolant pump motor and both main generators.

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 32165, 32186, 32187, 32375, 32386, 32544, 32555, and 32577.

32241 (AED-CONF-75-541-000, pp v) FOUNDATION RESEARCH AND OPTIMIZATION STUDIES FOR PRESTRESSED-CONCRETE REACTOR PRESSURE VESSELS FOR GAS-COOLED REACTORS. Schnellenbach, G. 1975. (In German).

From conference on research and development in the field of prestressed-concrete reactor pressure vessels; Berlin, F. R. Germany (13 Oct 1975).

Available from ZAED.

In prestressed-concrete reactor pressure vessels. Vol. 1. Introduction: Design-oriented research and development. (Deutscher Ausschuss fuer Stahlbeton, Berlin (F.R. Germany)).

A report is given on calculation methods, model tests, and material problems of reactor pressure vessels for gas-cooled reactors. Furthermore, constructive questions and system analytical studies are dealt with.

32242 (AED-CONF-75-553-033) EXPERIENCE GAINED FROM THE CONSTRUCTION OF THE THTR 300 MWe. Schoening, J.; Wittchow, G. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany)). 1975. 7p. (IAEA-SM-200/70). INIS.

From international symposium on gas-cooled reactors with emphasis on advanced systems; Juelich, F. R. Germany (13 Oct 1975).

4 figs. With abstract. Available from the IAEA.

Following some introductory remarks on the basic design, the time schedule up to the plant acceptance in 1977 is explained. Experience with subcontractors and necessary modifications of the safety concept are reported. (DE)

32243 (AED-CONF-75-553-046) IRRADIATION OF A HTGR FUEL ELEMENT. Leushacke, D. F.; Cords, H.; Semmler, J.; Spann, E. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany)). 1975. 18p. (IAEA-SM-200/33). INIS.

From international symposium on gas-cooled reactors with emphasis on advanced systems; Juelich, F. R. Germany (13 Oct 1975).

14 figs.; 4 tabs.; 2 refs. With abstract. Available from the IAEA.

The first representative segments of the standard HTGR 1160 MW(e) fuel element have been irradiated under operating conditions. The significance of this test was the first proof of the mechanical integrity of the fuel element, where even the maximum expected stress level achieved under normal operating conditions was exceeded. Design calculations on fuel blocks for an HTGR power plant showed that the graphite AS2-500 produced by SIGRI sees maximum stresses at a residence time of 1 year. Afterwards the differential shrinkage, the temperature gradients, and consequently the stresses, are reduced.

32244 (ANL-Trans-1041) THERMAL PERFORMANCE OF AN INSULATING STRUCTURE FOR A REACTOR VESSEL. Aranovitch, E.; Crutzen, S.; LeDet, M.; Denis, R. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Oct 1975. Translation of EUR-5256f. 54p. Dep. NTIS $4.50.

This report describes the installations used to test the HTGR reactor vessel insulating structure called "Casali" and details the experimental results in 3 groups: general experiments, systematic study, and technological experiments. The results obtained make it possible to satisfactorily predict the behavior of the structure in a practical application.

32245 (EUR-5256) THERMAL PERFORMANCES OF AN INSULATING STRUCTURE FOR A REACTOR VESSEL. Aranovitch, E.; Crutzen, S.; Le Det, M.; Denis, R. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Dec 1974. 56p. (In French). INIS.

The thermal and technological tests performed on a multilayer thermal insulation system for high temperature gas reactors are described. Included are descriptions of test facilities, global tests, interpretation of data, and technological tests. Results obtained make it possible to predetermine with a satisfactory precision thermal performance under various nominal conditions.

32246 (ORNL/TM-5266) CACA-2: REVISED VERSION OF CACA-A HEAVY ISOTOPE AND FISSION-PRODUCT CONCENTRATION CALCULATIONAL CODE FOR EXPERIMENTAL IRRADIATION CAPSULES. Allen, E. J. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 29p. Dep. NTIS $5.00.

A computer program is described which calculates nuclide concentration histories, power or neutron flux histories, burnups, and fission-product birthrates for fueled experimental capsules subjected to neutron irradiations. Seventeen heavy nuclides in the chain from ^{232}Th to ^{242}Pu and a user-specified number of fission products are treated. A fourth-order Runge-Kutta calculational method solves the differential equations for nuclide concentrations as a function of time. For a particular problem, a user-specified number of fuel regions may be treated. A fuel region is described by volume, length, and specific irradiation history. A number of initial fuel compositions may be specified for each fuel region. The irradiation history for each fuel region can be divided into time intervals, and a constant power density or a time-dependent neutron flux is specified for each time interval. Also, an independent cross-section set may be selected for each time interval in each irradiation history. The fission-product birthrates for the first composition of each fuel region are summed to give the total fission-product birthrates for the problem.

32247 (RD/B/N-2852) HIGH VOLTAGE ELECTRON MICROSCOPE STUDY OF BREAKAWAY SWELLING IN MAGNOX FUEL ELEMENTS. Baker, C. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1975. 23p. Dep. NTIS (US Sales Only) $3.50.

The present life limiting feature of the fuel elements in the British Magnox Reactors is the swelling of the uranium. It is now well established that aluminum at high levels reduces swelling, and the faster cooled bottom end of cast swells less than the top. The reasons for these variations were investigated using high voltage transmission and scanning electron microscopy of the fission gas distribution in two position 4 Trawsfynydd fuel bars containing 580 and 1040 ppm of aluminum. The irradiation growth stress produces a fine sub-grain structure in the adjusted uranium. The swelling can then be accounted for by a distribution of small intra-granular bubbles (20nm radius) at high pressure and coarser bubbles (50 to 500 nm radius) at lower pressure and located on the sub-grain boundaries. The finer the sub-grain structure in the critical temperature range, the greater is the fraction of the fission gas contained in the bubbles at the sub-grain boundaries, and the greater the swelling. The distribution of fission gas and the sub-grain size exhibit consistent variations with aluminum content and from top to bottom of cast. Breakway swelling starts when the gas bubbles reach the critical size for continuous enlargement by the growth stresses. The bubbles in the sub-grain boundaries are largest and will be first to attain the critical size. (auth)

32248 STATUS OF HTR FUEL ELEMENT DEVELOPMENT IN THE FRG AND ITS POTENTIAL FOR NUCLEAR PROCESS HEAT REACTORS. Nickel, H.; Balthesen, E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Kerntechnik; 17: No. 5, 205-214(May 1975).

10 figs.; 3 tabs.; 30 refs.

In the FRG three basic fuel element designs for application in high-temperature gas cooled reactors are being pursued: the spherical element, the graphite block element, and the molded block element (monolith). The state of development reached with the three types of elements, their specific merits and performance margins, and aspects of their future development potential for operating in advanced HTGR plants are presented. The development of coated feed and breed particles for application in all HTGR fuel elements is treated in more detail. It is summarized that all the fuel elements as well as their components have proven their aptitude for the steam cycle systems in many fuel element and particle performance tests. Further testing is still necessary, however, to adapt these fuel elements and

coated particles for advanced reactor concepts and to develop them up to full technical maturity. Ways of overcoming problems arising from the more stringent requirements are shown. (DE)

32249 EROSION EXPERIMENTS ON BOILER TUBES. Dynko, G. (Arbeitsgemeinschaft Versuchs-Reaktor G. m. b. H., Juelich (F. R. Germany)). VGB Kraftwerkstech.; 55: No. 10, 689-691(Oct 1975). (In German).

Erosion experiments should provide an explanation of the damage to adjacent tubes caused by tube bursts. It is shown that a few days will pass for sure from the appearance of the first small hole to greater damage to the boiler. (DE)

32250 APPLICATION OF DISODIUM-HYDROGEN-PHOSPHATE IN THE PASSAGE STEAM GENERATOR OF AN ENGLISH NUCLEAR POWER PLANT. Parry, D. J.; Tasker, P. W.; Tyldesley, J. D. (Central Electricity Generating Board, Manchester (UK). North Western Region). VGB Kraftwerkstech.; 55: No. 2, 105-109(Feb 1975). (In German).

6 figs.; 13 refs.

Ionized impurities in the water-steam cycle of a nuclear heated once-through forced flow boiler and tests with the part model of a low pressure once-through forced flow boiler are dealt with. (DE)

32251 STRING NET CONSTRUCTION FOR A COOLING TOWER. VDI (Ver. Dtsch. Ing.) Nachr.; 29: No. 33, 6(Aug 1975). (In German)

On the site of the VEW power station "Westfalen" near Uentrop-Schmehausen, 40 km east of Dortmund, a string net cooling tower is being constructed for the 300 MW THTR nuclear power station now under construction. The building, which has a total height of 180 m, will have a top diameter of 141 m. Its air outlet opening will be at a height of 146 m. (DE)

32252 EXPERIMENTAL CHANNEL WITH TWO FUEL RODS FOR THE FIRST ATOMIC POWER REACTOR. Bul'kanov, M. G.; Kurov, V. A.; Lazarevskaya, V. D.; Potolovskii, V. G.; Sever'yanov, V. S. At. Energ. (USSR); 39: No. 4, 247-249(Oct 1975). (In Russian)

Designs of experimental channels with two fuel rods for the first atomic power reactor are described. The channels are identical to standard ones as regards fissionable material loading. This makes it possible to conduct serial testing of new types of fuel rods without disturbing the physical characteristics of the reactor core. Data characterizing the design operability are presented.

32253 ROLE OF GAS AS A COOLANT IN THE DEVELOPMENT OF ATOMIC POWER STATIONS. Anan'ev, E. P.; Kruzilin, G. N. At. Energ. (USSR); 40: No. 1, 3-10(Jan 1976). (In Russian)

The development of gas reactors from the use of CO_2 to He coolants is described. The authors demonstrate the disadvantages of CO_2 coolant and the promising advantages of helium: possibility of achieving high temperatures, high efficiencies and good specific reactor indicators. Promising types of fuel and design of fuel elements for high-temperature power reactors are described.

32254 ANNULAR FUEL ELEMENT FOR HIGH-TEMPERATURE REACTORS. Bujas, R. (to Commissariat a L'Energie Atomique). US Patent 3,928,132. 23 Dec 1975. Priority Date 29 Apr 1971, France. 2p.

A description is given of a compacted fuel element of annular shape which is enclosed in a graphite casing constituted by an inner tube and an outer tube. The inner tube is formed of graphite having a lower coefficient of shrinkage than the graphite of the outer tube under irradiation and is of smaller thickness than the outer tube.

32255 THE GERMAN INDUSTRIAL PROGRAM ON HIGH TEMPERATURE REACTORS. Its Advances and Prospects. Mueller, H. W.; Oehme, H. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany)). pp 219-238 of Advanced Nuclear Reactors. Rome; CERN (1974).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The advances and prospects of the German industrial program on high temperature reactors are reviewed. The fuel element concept and the design and technology of the HTR 300 MW(e) prototype plant and the commercial 1160 MW(e) Dual-Cycle plant are described. Advanced development projects are also reported. (INIS)

32256 EXPERIENCE GAINED IN THE DRAGON PROJECT WITH THE SNAM PROCESS OF KERNELS MANUFACTURE FOR THE HTR FUELS. Facchini, A.; Gallone, S.; Gerontopulos, P. (AGIP Nucleare, Milan (Italy)); Graham, L. W.; Price, M. S. T. (Organization for Economic Co-Operation and Development, Winfrith (UK). High Temperature Reactor Project). pp 183-202 of Advanced Nuclear Reactors. Rome; CNEN (1974).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

Experience gained with the HTR fuel manufacture and irradiation tests made by SNAM for the Dragon project is reported. The fabrication of kernels for use in HTR by gel-supported precipitation is described and the experimental results are discussed. Data are reported. (INIS)

32257 NUCLEAR POWER STATIONS EQUIPPED WITH HIGH TEMPERATURE GAS COOLED REACTORS. Fischer, P. U.; Meyer, L. (Gulf General Atomic Europe, Zurich (Switzerland)). pp 203-217 of Advanced Nuclear Reactors. Rome; CNEN (1974).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The technical evolution of nuclear power stations equipped with a high temperature gas-cooled reactor are reviewed to their present state of commercial maturity. The Peach Bottom atomic power station and the Fort St. Vrain nuclear generating station are described, reporting the plant construction problems and the operating experience. The present status of the large HTGR power plants and their future potential are described. (INIS)

32258 THE STATUS OF FUELS AND METALS FOR HIGH TEMPERATURE GAS COOLED REACTORS. Graham, L. W.; Huddle, R. A. U.; Price, M. S. T. (Organization for Economic Co-Operation and Development, Winfrith (UK). High Temperature Reactor Project). pp 151-181 of Advanced Nuclear Reactors. Rome; CNEN (1974).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). 101 refs. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The status of fuels and metals for high temperature gas-cooled reactors is presented, reporting material characteristics, fuel fabrication processes and facilities. The present state of knowledge of fuel and metallic alloys for the core and primary circuit of steam cycle HTR's are also surveyed. (INIS)

32259 EXPERIENCE IN CONSTRUCTING LARGE NUCLEAR POWER PLANT IN THE USSR. Dollezhal, N. A.; Emelyanov, I. Ya. At. Energ. (USSR); 40: No. 2, 117-126(Feb 1976). (In Russian)

Experience gained in the development of graphite-uranium channel reactors, from the reactor of the world's first nuclear power plant to the world's largest reactors of the PBMK type, is summarized. Technical characteristics and advantages of the PBMK-1000 reactor and the main results obtained in constructing this type reactor and during start-up of the first and second blocks of the Leningrad Atomic Power Plant are given. The main technical characteristics and advantages of the sectioned modular PBMKII-2000 reactor designed for a capacity of 2000 MW(e) are considered. The considerable advantages of nuclear superheating of steam incorporated in this reactor design are discussed. Prerequisites for the future development of channel reactors, one of the basic types in the future growth of power in the Soviet Union, are considered.

32260 NUCLEAR START-UP OF REACTOR P5MK IN THE SECOND BLOCK OF THE LENINGRAD ATOMIC POWER STATION. Emelyanov, I. Ya.; Egiazarov, M. B.; Ryabov, V. I. At. Energ. (USSR); 40: No. 2, 127-132(Feb 1976). (In Russian)

The main stages of nuclear start-up in the second block of the Leningrad Atomic Power Station are described. Engineering tests of the major systems are enumerated and the fuel loading scheme is described. Experimental results are compared with those obtained during start-up of the first block. The effect of technological core parameter deviations from nominal values on multiplying properties is analyzed. The method of initial loading of the reactor is described. The results of measuring the reactivity effect for fuel channels and control and safety rod channels deprived of water are presented. Also given are the results of measuring the effectiveness of the control rods. The measured power density distribution is compared with the calculated values.

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 29451 and 32553.

32261 MAGNETS IN FUEL BUNDLES AID VIBRATION STUDIES. Nucl. Can./Can. Nucl.; 14: No. 5, 6(May 1975). (In English, French).

Fuel bundle vibration in a reactor fuel channel can be measured from the outside of a coolant tube by the use of magnets installed in the fuel elements. The magnets which are ½ inch long and ⅛ inch in diameter are encased in Zircaloy capsules, inserted in holes drilled in the fuel elements, and welded to the Zircaloy fuel sheath. For a 37 element Bruce bundle, 10 to 15 magnets are needed.

32262 SHARE OF SKODA TRUST IN NUCLEAR POWER DEVELOPMENT WITHIN CMEA. Klail, V. (Skoda, Plzen (Czechoslovakia)). Rev. Prum. Obchodu; 12: No. 1, 23-25(1975). (In Czech).

The participation is discussed of SKODA Trust in the construction of the A-1 nuclear power plant at Jaslovske Bohunice and in nuclear power plants V-1 and V-2 currently under construction. Prerequisites are listed of implementing the production program of reactor instrumentation to meet the future needs of CMEA countries. Main parameters are given of power reactors included in the production program.

32263 MAXIMUM OUTPUT OF THE KS-150 REACTOR AT A NONUNIFORM RADIAL DISTRIBUTION OF BURNUP. Kochurov, B. P.; Egorychev, N. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). Jad. Energ.; 21: No. 6, 201-205(Jun 1975). (In Russian).

The optimum radial distribution of fuel burnup safeguarding the maximum reactor output was obtained in stationary operational conditions of the KS-150 reactor using optimization program ROC. The calculated results are presented showing the effect of reactivity, the average fuel burnup, the nonuniform distribution of neutron absorbers and the relative volume of uranium in the fuel element on reactor output. (auth)

32264 EXPERIMENTS ON THE TR-0 REACTOR LINKED WITH THE PHYSICAL START-UP OF THE A-1 REACTOR. Bardos, J.; Hrazdil, O.; Hudec, F.; Kryl, F.; Mikus, J.; Osmera, B.; Rypar, V.; Svoboda, C.; Turzik, Z. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Jad. Energ.; 21: No. 6, 205-211(Jun 1975). (In Russian).

The methods and the results of experiments carried out during the first stage of the TR-0 reactor operation are reported. The experiments complete the measurements accomplished on the KS-150 reactor during its start-up. The experiments involve the measurement of criticality, neutron migration anisotropy, reactivity, temperature, and moderator level coefficients, neutron macro- and micro-flux distributions as well as the measurement of reactivities of some reactor core components. (auth)

32265 TRANSPORTATION OF IRRADIATED FUEL SAMPLES FROM THE A-1 POWER PLANT TO THE INST. OF NUCLEAR RESEARCH AT REZ. Lukavsky, J. Jad. Energ.; 20: No. 1, 27-28(Jan 1974). (In Czech).

The manner and safety measures taken in the transport of samples of irradiated fuel pins from the hot chamber at the A-1 nuclear power plant to the hot chambers of the Institute of Nuclear Research at Řež are described. Transported were 200 mm long parts of fuel pins having the maximum activity of 600–700 Ci prior to transport. (Nuclear Sci. Abstr. Czech.)

32266 POSSIBLE USES OF HEAVY WATER REACTORS AND POTENTIAL OF CIRENE REACTORS. Barabaschi, S. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)); Castelli, G. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)); Silvestri, M. (Centro Informazioni Studi Esperienze, Milan (Italy)). pp 139-150 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

Future possible developments of the heavy water reactor are investigated making a comparative evaluation of the more promising reactor types. Technical and economic characteristics are compared and the data are reported. The possibility of development of the CIRENE reactor is also examined and discussed. (INIS)

32267 THE PRESENT STATUS AND FUTURE DEVELOPMENT OF HEAVY WATER REACTORS IN CANADA. Gray, J. L.; MacKay, I. N. (Atomic Energy of Canada Ltd., Ottawa, Ontario). pp 27-38 of Advanced Nuclear Reactors. Rome; CNEN (1974).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The present status and the future development of heavy water reactors in Canada are described. The performances of the CANDU-PHW system are presented and ways of improving the system are indicated. The severe heavy water shortage caused by the failure of the first heavy water plant is expected to end in the mid 1970's. (INIS)

32268 THE CIRENE RESEARCH AND DEVELOPMENT PROGRAM. Mancini, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)); Villani, S. (Centro Informazioni Studi Esperienze, Milan (Italy)). pp 59-97 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The research and development program for the CIRENE reactor is described in detail. The problems solved in thermodynamics, reactor physics, reactor control, fuel element design and manufacture, test experiments to check safety requirements are presented and discussed and comparative evaluations with similar activities in other countries are also reported. (INIS)

32269 ADVANTAGES OF THE SGHWR CONCEPT AND OPERATING EXPERIENCE. Moore, J. (UKAEA). pp 99-119 of Advanced Nuclear Reactors. Rome; CNEN (1974).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The SGHWR system is presented and discussed. The prototype design and operating experience are discussed looking into the control and shutdown systems, the engineering features, the water chemistry and materials problems. The advantages of the SGHWR are also evaluated and SGHWR design parameters are reported. (INIS)

32270 FAILED FUEL LOCATION IN CANDU-PHW REACTORS USING A FEEDER SCANNING TECHNIQUE. Lipsett, J. J.; Stewart, W. B. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 321-324(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A feeder-scanning technique that involves the measurement of gamma-ray fields on individual fuel-channel outlet-feeder pipes has been used successfully to locate failed fuel bundles in shutdown CANDU-PHW reactors at the Pickering G.S. High-resolution spectroscopic measurements show that the excess gamma-ray fields on the outlet feeders of channels containing fuel failures are due primarily to deposited fission products, all with half-lives longer than 56 hours.

32271 DELAYED-NEUTRON SYSTEMS FOR FAILED FUEL LOCATION IN CANDU REACTORS. Lipsett, J. J.; Tseng, C. M. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 325-330(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The engineering and operational requirements for failed-fuel location systems in CANDU reactors are constantly evolving and the effects of these changes on system design are discussed, with particular reference to the location system for the Bruce G.S. An experimental program to optimize the counting arrangement for the Bruce failed-fuel location system is described in detail.

32272 NUCLEAR INSTRUMENTATION AND CONTROL OF THE CANDU PICKERING GENERATING STATION. Kee, F. J. (Ontario Hydro, Toronto). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 770-778(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The performance of the nuclear instrumentation and control equipment at the Pickering Generating Station is described.

Power Reactors, Breeding

Refer also to abstracts 28819, 29452, 29453, 30044, 30396, 30397, 30401, 30403, 30406, 32369, 32379, 32382, 32410, 32412, 32415, and 32437.

32273 (AI-ERDA-13154) SODIUM TECHNOLOGY AND COVER GAS SEAL DEVELOPMENT PROGRAMS. Annual Technical Progress Report, Government Fiscal Year 1975. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Aug 1975. Contract AT(04-3)-824. 369p. AT.

Progress is reported in the areas of sodium removal-storage, alcohol-sodium removal process development, CRBRP alcohol-sodium removal process support, hot gas lance study, evaporative removal of sodium, sodium-water reaction products removal, friction tests of FFTF components, general seal development, FFTF and CRBRP inflatable seals, top shield dip seal configura-

tion characterization, advanced seal geometries and materials, and sodium vapor tests. (JWR)

32274 (ANL-Trans-1053) LARGE COMPONENTS OF FAST BREEDER REACTORS. Kayser, G.; Robin, G.; Duchatelle, L.; Birault, J.; Lions, N.; Biscarel, J.; Schwab, B.; Lafon, A. Translated from Bull. Inf. Sci. Tech. (Paris); No. 182, 39-52(Jun 1973). 29p. Dep. NTIS $4.00.

The increasing size of the main components of fast breeder reactors: steam generators, intermediate heat exchangers, and pumps gives rise to problems in design, manufacture, and testing. Many of these problems can be solved by extrapolating the Phenix designs. In certain cases, it is necessary to maintain a development program for some of the components. The steam generators for the 1200 MW(e) reactor have to be different from the Phenix ones for reasons of simplicity and economy.

32275 (GEAP-14078-1) ADVANCED LMFBR CORE DESIGN. First Quarterly Report, July–September 1975. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Oct 1975. Contract E(04-3)-893. vp. AT.

The objective of the work reported here is to conduct studies of advanced LMFBR core design options to aid the focusing of the national programs on advanced oxide fuels, materials, core designs and core systems.

32276 (INIS-mf-1945) ANNUAL REPORT 1974. Sodium Technology Development Programme. (Nijverheidsorganisatie TNO, The Hague (Netherlands). Projectgroep Kernenergie TNO). 1975. 24p. (In Dutch). INIS.

The sodium technology development program comprises a number of separate research programs in the field of designing and testing parts and components for the SNR-300 reactor. Design studies and theoretical studies on cold trapping and the behavior of hydrogen in sodium circuits are reported. A preliminary test program for fighting sodium fires is completed. Results of research done on vibration measurements and count-current mixing in a dummy tube bundle of a S.N.R. spiralized steam generator with counter-current flow are reported briefly. Research done in the field of heat transfer, pressure drop and bubble dynamics of a straight pipe steam generator are also briefly reported. To determine the influence of spiral diameter of the spiralized pipe on heat transfer in a spiralized pipe heat exchanger, a second test section will be built in 1975. Research was reported on pump viscoseals, bearing stability, rotordynamics and bearing materials for sodium pumps. Research done on the properties of SNR-construction materials at high temperature and long time exposure and corrosion in sodium are reported. Fundamental research on corrosion accompanied this research. The report closes with results of weldability, mechanized-welding and remote welding of sodium-wetted surfaces.

32277 (NIIAR-P-229) OPTIMIZATION OF THE DOUBLING TIME AND THE FUEL COSTS FOR FAST REACTORS BY PARTIAL FUEL RELOADING. Grachev, E. A.; Dejnega, N. L.; Afanas'eva, L. D. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Melekess (USSR)). 1974. 17p. (In Russian). INIS.

32278 (ORNL/TM-5196) PROCUREMENT OF TYPE 316 STAINLESS STEEL REFERENCE HEAT FOR LMFBR RESEARCH AND DEVELOPMENT PROGRAMS. Beaver, R. J.; Martin, W. R. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 80p. AT.

Various sizes of plate, sheet, pipe, rounds, and forgings were produced from a 200-ton air-melted heat of type 316 stainless steel, heat 8092297, made by the Republic Steel Corporation. These items were procured by the Union Carbide Nuclear Division and are stockpiled at the Oak Ridge National Laboratory for disbursement as reference material to ERDA contractors responsible for research and development associated with the Liquid Metal Fast Breeder Reactor Program. This reference material is characterized by singular control of chemical composition; specific traceability of items to each ingot cast; and of the highest quality complying with the requirements of the RDT Standard F 2-4T, Quality Verification Requirements, and the RDT material standards. The considerations involved in establishing specification requirements for this reference material are presented and the procurement specification ORNL-MC-316 appended. Processing and inspection activities are described, and traceability of each item to the ingot cast is presented in detail. The specific results obtained as verification of the chemical composition and the mechanical properties are listed for each size of item procured.

32279 (WARD-NA-3045-28) SODIUM TECHNOLOGY PROGRAM: FRICTION, WEAR, AND SELF-WELDING. Quarterly Progress Report for Period Ending July 31, 1975. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1975. Contract E(11-1)-3045. 90p. AT.

Progress is summarized in the following areas: sodium friction and wear testing; self-welding evaluation in sodium; sodium compatibility of low-friction materials; and effects of sodium mass transfer on pressure drop.

32280 (WNICD-2380A43) SODIUM IONIZATION LEAK DETECTOR. Annual Progress Report for Period Ending June 30, 1975. Lane, S. A. (Westinghouse Electric Corp., Hunt Valley, Md. (USA). Nuclear Instrumentation and Control Dept.). Jul 1975. Contract AT(11-1)-2499. 84p. AT.

The Sodium Ionization Detector (SID) is under development as a small, sensitive sodium-to-gas leak detector for the LMFBR. It relies on the relative ease with which sodium and sodium-containing compounds can be thermally ionized. Work accomplished during the fiscal year includes tasks on sensor design optimization, sensor response studies, electrical signal generation and processing, and simulated reactor environment testing. The results have verified the high sensitivity of the instrument under a variety of test conditions in the laboratory and at LMEC and have confirmed the adequacy of the reference sensor design. Further work will be performed to obtain the remaining necessary information for plant application.

32281 OXYGEN REDISTRIBUTION AND ITS MEASUREMENT IN IRRADIATED OXIDE FUELS. Adamson, M. G. (General Electric Co., Pleasanton, Calif. (USA). Vallecitos Nuclear Center); Aitken, E. A.; Evans, S. K. (General Electric Co., Sunnyvale, Calif. (USA)); Davies, J. H. (General Electric Co., San Jose, Calif. (USA)). pp 2 of Thermodynamics of Nuclear Materials 1974. Proceedings of a Symposium Held by the IAEA at Vienna, 21-25 October 1974. Vienna; IAEA (1975).

From symposium on the thermodynamics of nuclear materials; Vienna, Austria (21 Oct 1974). (International Atomic Energy Agency, Vienna (Austria)).

The results of several new series of ex-reactor thermal gradient experiments performed on hypostoichiometric mixed oxide and hyperstoichiometric urania, with and without added caesium, are presented and discussed in terms of an oxygen transport model applicable to irradiated LMFBR fuel pins. Mixed oxide tests were carried out with variable numbers of pellet interfaces in a fixed temperature gradient, and also with molybdenum barriers placed between pellets, to examine the effects periodic formation and disappearance of cracks and pores in neutron irradiated fuel will have on the oxygen transport mechanism. Differences in the heats of transport measured in these tests are attributed to local oxygen potential gradients which quickly develop across fuel-gas-fuel interfaces during the approach to steady state. Thermomigration studies on caesium oxide fuel systems have demonstrated that caesium fission products will participate in the over-all oxygen redistribution process in irradiated oxide fuels. The effectiveness of caesium as an oxide carrier in a temperature gradient is shown to depend on the over-all oxygen activity of the fuel and the hydrogen content of the gas phase. An emf oxygen probe, based on a solid oxide electrolyte high temperature galvanic cell, has been developed to measure oxygen potentials and oxygen gradients in irradiated oxide fuels. The feasibility of making such measurements was demonstrated by probing four transverse fuel sections cut from a series of low and high burn-up irradiated Zircaloy-clad urania fuel rods. The results are interpreted in terms of current chemical models for irradiated oxide fuel. (auth)

32282 THE NECESSITY OF THE DEVELOPMENT OF FAST BREEDERS. Difficulties and Future Aspects. Eitz, A. W.; Wahl, D. J. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Essen (F. R. Germany)). Energiewirtsch. Tagesfragen; 25: No. 9/10, 466-469(Sep 1975). (In German)

3 figs.

Following an explanation of the economic significance of breeder reactors, a survey is given on the European development in the field of breeder reactors. (DE)

32283 STEAM GENERATOR TEST LOOP FOR SODIUM COOLED FAST BREEDER REACTOR. Inoue, K.; Kanagae, N.; Makino, K.; Nikai, I. IHI Eng. Rev.; 7: No. 3, 96-111(Sep 1974).

In the development of the liquid metal cooled fast breeder reactor (LMFBR), the steam generator (SG) is considered the component which requires preferential development. In Japan, the helical-coiled heat transfer tube-type SG was decided upon as one of the SG types for the LMFBR, and research and development will proceed. However, this type possesses some problems to be solved, such as boiling in the downcomer and multi-channel flow instability during low load operation. This test loop was designed and manufactured for the purpose of proving thermal and hydrodynamic performance and obtaining basic experimental data for the problems mentioned above. The steam generator (SG) installed in this loop is provided with three helical-coiled heat transfer tubes (19.0 mm O.D. 3.2 mm t 25.0 mL for heat transfer

section) with a heat transfer capacity of about 0.2 MW(t). The preoperation data has proven itself under actual operating conditions (steam condition: 132 kg/cm^2/g at 487°C, 0.32 t/h).

32284 ECONOMIC PERSPECTIVE OF THE LMFBR. Levenson, M.; Murphy, P. M.; Zaleski, C. P. L. Nucl. News; 19: No. 5, 54-59(Apr 1976).

Actual construction cost data for early U. S. LWR's and sodium-cooled reactor power plants, after normalization with respect to rating, economic conditions, and technical content, show the sodium-cooled systems to cost no more than 38 percent above LWR's. However, more recent French experience with larger units has shown the cost difference to be no more than 1.5 percent. Analytical studies have estimated less than 20 percent. Based on a subjective weighting of these data, we conclude that the most likely capital cost difference between fully developed commercial-sized LMFBR's and LWR's will be less than 20 percent.

32285 MEASURING SYSTEMS USED IN REACTORS WITH SODIUM COOLANT. Bergmann, W.; Hottmann, D. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). Arch. Tech. Mess. Messtech. Prax.; No. 472, 73-76 (May 1975). (In German)

The measuring processes discussed in the present work describe the determination of all important process technical parameters in the reactor, in the Na flowed main and auxiliary purification systems including the measuring probe in the protection gas systems which are exposed to Na aerosols or Na activity. The Na probes, after many years of testing in experimental plants mostly in the compact Na-cooled nuclear power plant (KNK) in Karlsruhe, have been further developed for their application in fast Na-cooled reactors (SNR). Their signaling has been chosen in such a way that, due to radioactivity in the primary system, a calibration is easily possible from a distant passable position and the connecting to the measured value processing as well as to the reactor protection system can reliably take place. (DE)

32286 STATISTICAL CHARACTERISTICS OF TEMPERATURE PULSATIONS IN A ONCE-THROUGH SODIUM-WATER STEAM GENERATOR MODEL. Kabadze, B. V.; Sroelov, V. S.; Kul'pin, B. V.; Gavrilin, A. I. At. Energ. (USSR); 39: No. 4, 250-254 (Oct 1975). (In Russian)

Temperature pulsations in a once-through sodium-water steam generator model are investigated experimentally. It has been established by the cross-correlation method that pulsations at the beginning of the deteriorated heat-exchange zone are associated with small fluctuations of water flow through the steam generator. The main source of temperature pulsations outside of this zone is the motion of turbulent formations in the section of non-stabilized flow in the transverse temperature gradient.

32287 TESTING OF BN-600 EXPERIMENTAL FUEL ELEMENTS VARIOUS BURN-UPS IN REACTOR BOR-60. Antipina, M. M.; Bibilashvili, Yu. K.; Golovnin, I. S. At. Energ. (USSR); 40: No. 1, 16-27(Jan 1976). (In Russian)

Results of the investigation of experimental fuel elements are presented. The authors discuss fuel element construction, basic testing parameters, results of measuring gas release from fuel, deformation of cladding and swelling of steel, and also data on material investigations of macro- and micro-structures of fuel and cladding with an analysis of the degree and character of their physico-chemical interaction with fission fragments.

32288 BASIC PROPOSITIONS OF FORECASTING OPERATION CAPABILITY OF SODIUM-COOLED FAST REACTOR OXIDE FUEL ELEMENTS. Golovnin, I. S.; Likhachyov, Yu. I. At. Energ. (USSR); 40: No. 1, 27-37(Jan 1976). (In Russian)

Basic parameters affecting operation capability of sodium-cooled fast reactor oxide fuel elements have been determined, principles for selecting their optimal values proposed, and basic phenomena arising in oxide fuel elements during operation considered. Dynamic models of thermally stable and sturdy design of fuel elements and criteria for estimating operational reliability based on theoretical considerations and experimental data on the behavior of materials in and outside of reactors have been selected.

32289 NUCLEAR REACTOR ELEMENT. Goetzmann, C. (to Siemens Aktiengesellschaft). US Patent 3,928,129. 23 Dec 1975. Priority Date 31 Aug 1972, German, Federal Republic of (F. R. Germany). 4p.

A nuclear reactor element is described which includes a vertically operating, elongated tubular gas-coolant duct in which a bundle of reactor rods having metal casings is positioned, the duct having an adjustable flow choke in its upper end portion above the bundle of rods and the duct having a lower portion extending below the bundle. A plurality of such elements are operated in parallel in a gas-coolant breeder reactor with the flow chokes of each individually adjusted to obtain a uniform coolant temperature discharging through their lower portions. For emergency use the element has a static non-adjustable flow choke positioned in its lower portion by material which deforms and permits this static choke to fall, if heated by coolant heated by the reactor rod casings operating at excessively high temperatures. This static flow choke is designed so that the adjustable flow choke may be adjusted to provide a coolant flow for normal operation but which would provide for a somewhat larger flow passage in the absence of the choke. Therefore, if due to abnormal operation the static choke falls, a larger coolant flow passage is immediately established without requiring adjustment of the adjustable flow choke.

32290 ASYMPTOTIC ANALYSIS OF THE AVERAGE, STEADY, ISOTHERMAL FLOW IN COUPLED, PARALLEL CHANNELS. Lund, K. O. (General Atomic Co., San Diego, CA). J. Heat Transfer; 98: No. 1, 19-25(Feb 1976).

The conservation equations of mass and momentum are derived for the average flow of gases in coupled, parallel channels, or rod bundles. In the case of gas-cooled rod bundles the pitch of the rods is relatively large so the flows in the channels are strongly coupled. From this observation a perturbation parameter is derived and the descriptive equations are scaled using this parameter, which represents the ratio of the axial flow area to the transverse flow area, and which is of the order of 10^{-3} in current gas-cooled fast breeder reactor designs. By expanding the velocities into perturbation series the equations for two channels are solved as an initial value problem, and the results compared to a finite difference solution of the same problem. The N-channel problem is solved to the lowest order as a two-point boundary value problem with the pressures specified at the inlet and the outlet. It is concluded from the study that asymptotic methods are effective in solving the flow problems of rod bundles; however, further work is required to evaluate the possible computational advantages of the methods.

32291 BEHAVIOR OF INERT GAS BUBBLES IN FORCED CONVECTIVE LIQUID METAL CIRCUITS. Minkowycz, W. J.; France, D. M.; Singer, R. M. (Argonne National Lab., IL). J. Heat Transfer; 98: No. 1, 5-11(Feb 1976).

Conservation equations are derived for the motion of a small inert gas bubble in a large flowing liquid-gas solution subjected to large thermal gradients. Terms which are of the second order of magnitude under less severe and steady-state conditions are retained, thus resulting in an expanded form of the Rayleigh equation. The bubble dynamics is a function of opposing mechanisms tending to increase or decrease bubble volume while being transported with the solution. Diffusion of inert gas between the bubble and the solution is one of the most important of these mechanisms included in the analysis. The analytical model is applied to an argon gas bubble flowing in a weak solution of argon gas in liquid sodium. Calculations are performed for these fluids under conditions typical of normal and abnormal operation of a liquid metal fast breeder reactor (LMFBR) core and the resulting bubble radius, internal gas pressure, and mass of inert gas are presented in each case. An important result obtained indicates that inert gas bubbles reaching the core inlet of an LMFBR will always grow as they traverse the core under normal and extreme abnormal conditions and that the rate of growth is quite small in all cases.

32292 VOLUME DISPLACING MODULES FOR LIQUID METAL COOLED NUCLEAR REACTORS. Noyes, R. C. (to Combusion Engineering, Inc.). US Patent 3,929,566. 30 Dec 1975. Filed Date 25 Jun 1973. 8p.

A system is described wherein a plurality of volume displacing modules are removably positioned in the peripheral space between a liquid metal cooled reactor vessel and the walls of the containment structure forming a vessel cavity in which the vessel is disposed to insure that the level of coolant in the reactor vessel remains above a predetermined elevation in the event of coolant leakage into the vessel cavity. The reactor vessel is provided with an excess volume of liquid metal coolant. The total volume of the modules positioned in the peripheral space below the predetermined elevation is such that the coolant containing volume in the peripheral space with the modules in place is less than the volume of excess liquid metal coolant in the reactor.

32293 SOME RESULTS OF ENGINEERING AND ECONOMIC ANALYSIS OF A DIRECT CYCLE POWER STATION. Popyrin, L. S.; Starostenko, N. N.; Malevskij, A. M. (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 1, 9-12(1975). (In Russian).

32294 HELIUM-COOLED FAST REACTORS. Adamik, V. Jad. Energ.; 21: No. 6, 233-237(Jun 1975). (In Czech).

Principal knowledge is summarized on gas-cooled fast breeder

reactors. The questions of nuclear safety of the reactors are discussed in more detail.

32295 DEVELOPMENT OF HIGH-OUTPUT FAST REACTORS. Suransky, F. Jad. Energ.; 21: No. 6, 223-229(Jun 1975). (In Czech).

The state and the program of the development of high-output fast reactors in France, FRG, and Great Britain are described. In France, attention is focused on the Superphenix reactor (3,000 MWt, 1,200 MWe) project which is to be a further development stage following the 250 MWe Phenix reactor. In the FRG efforts are under way on the project of the SNR-2 (2,000 MWe) loop reactor. The British program envisages the construction of approximately 40 fast reactors CFR-1 and CFR-2, each with an output of 1,700 MWe till the year 2000.

32296 MONITORING OF OXYGEN AND HYDROGEN IN A SODIUM LOOP BY MEANS OF ELECTROCHEMICAL METHODS OF MEASUREMENT. Ullmann, H.; Teske, K.; Reetz, T. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)); Kozlov, F. A.; Kuznecov, E. K.; Kozub, P. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Kernenergie; 18: No. 7, 221-229(1975). (In German).

The contents of oxygen and hydrogen impurities in an experimental sodium loop have been monitored by means of electrochemical methods of measurement employing galvanic cells with solid electrolytes. Calibration curves for the potential of cells containing a ThO_2–Y_2O_3 electrolyte as a measure of oxide concentration in sodium have been obtained using the vacuum distillation technique for sodium samples. The absolute amounts of cell potential of individual cells differ from each other by some percent under the same conditions of measurement and, consequently, a calibration has to be performed. The concentration, temperature and pressure coefficients of cell potential have been determined. The behavior of cell potential in long-term operation has been studied. The oxygen partial pressure of the inert gas has been monitored by means of a cell containing a ZrO_2–CaO electrolyte.

32297 FAST NEUTRON REACTORS AND THEIR ROLE IN THE DEVELOPMENT OF ATOMIC POWER. Voronin, L. M., Karelin, E. P. Elektr. Stn.; No. 10, 8-11(1975). (In Russian)

Data are presented concerning development in the USSR of reactor-breeders with sodium cooling. The principal concepts concerning the main parameters of two such reactors, the BN-350 and BN-600, are given. The role of an atomic electric power plant with fast neutron reactors in governing the load of power systems is briefly formulated. Photographs are shown of the principal building of the III block of the Beloyarskiy Atomic Electric Power Plant which contains the 600,000 kW BN-600 reactor, and the reactor hall of the III block. The principal scheme of the III block and a detailed sketch of the BN-600 reactor are also shown. 4 figures; 5 references.

32298 EQUIPMENT CELL LINERS FOR LIQUID-METAL-COOLED FAST BREEDER REACTORS. Chapman, R. H. (Oak Ridge National Lab., TN). Nucl. Saf.; 17: No. 2, 208-215(1976).

Concepts and practices used in the design of equipment cell liners for liquid-metal-cooled fast breeder reactor (LMFBR) systems were surveyed to ascertain the manner by which the functional requirements were satisfied, the severity of sodium spills the liners were designed to accommodate, and the problems encountered in design and construction. The survey was limited to "loop-type" LMFBRs, with primary interest on recently constructed plants. Steel-lined concrete structures are discussed; cell-liner designs used in several LMFBR plants are described with particular emphasis on the Southwest Experimental Fast Oxide Reactor (SEFOR), which uses a fixed liner, and the Fast Flux Test Facility (FFTF), which uses a free-floating liner; and research and development work believed necessary to permit a rational and thorough assessment of cell-liner design concept is identified.

32299 METHOD FOR HANDLING IRRADIATED FUEL ASSEMBLIES IN A FAST NEUTRON NUCLEAR REACTOR AND AN INSTALLATION FOR CARRYING OUT SAID METHOD. Aubert, M.; Merland, D. (to CEA, 75 – Paris (France)). French Patent 2,235,462/A/. 27 Jun 1973. 13p. (In French).

Available from Institut National de la Propriete Industrielle, Paris, (France).

Description is given of a method for handling irradiated fuel assemblies in a fast neutron nuclear reactor. This method is characterized in that it comprises the steps of immediately extracting from the reactor vessel an irradiated assembly having a high residual power with no storage at all within the vessel, transferring said assembly under a layer of liquid metal up to a container outside the vessel, by transporting said assembly in a jar specially designed for expelling the heat generated by said assembly extracting the assembly from said jar in said container for putting it on a transfer mechanism under a layer of liquid metal, inserting said assembly into a tight sheath and finally enclosing said sheath in a shield flask or cask. This can be applied to high power reactors. (FR)

32300 THE PEC REACTOR. Aiello, P.; Tabellini, G. L. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Programma Reattori Veloci); Zona, R. (Consortium Corepec, Milan (Italy)). pp 291-313 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The PEC reactor characteristics are reported in detail. The plant layout, the core coolant circuit, and the fuel elements are described. The plant design and construction status and planned activities are discussed. (INIS)

32301 THE ELECTRIC UTILITIES AND THE BREEDER REACTORS. Angelini, A. M. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). pp 593-603 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

A general survey of the performances and prospects of the fast reactors (breeder) is reported particularly looking at the safety, economics, reliability, and compatibility problems. The activities of the European electric power producers in the field are also reported and discussed. (INIS)

32302 RESEARCH AND DEVELOPMENT PROGRAM FOR FAST REACTORS IN ITALY. Bianchi, G.; Fizzotti, C. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). pp 315-365 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The research and development programs for fast reactors in Italy are described in detail. The PEC project activities, the test facilities for the reactor components, the safety studies and experiments, the fuel element research, the sodium-reactor components design, the instrumentation problems, and the computation codes development are reported. (INIS)

32303 RESEARCH AND DEVELOPMENT PROGRAMS FOR FAST REACTORS IN ITALY. Bruzzi, L.; Casalini, P.; Tabellini, G. L. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Programma Reattori Veloci). pp 367-400 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The research and development program for fast reactor in Italy is presented. The PEC design and construction problems are discussed, reporting also the test experiments for safety, physics and engineering solutions, computer codes development and fuel element design suggestions. (INIS)

32304 RESEARCH AND DEVELOPMENT PROGRAM FOR FAST REACTORS IN ITALY. Gambardella, G. (Progettazioni Meccaniche Nucleari, Genoa (Italy)). pp 421-470 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The research and development program for fast reactors is reported in detail. The design and construction problems for the steam generators and the heat exchangers of sodium plants are described reporting technical data and construction experiences and discussing test experimental results. Experimental circuits are also described. (INIS)

32305 THE RESEARCH AND DEVELOPMENT PROGRAM FOR FAST REACTORS IN ITALY. Ghinaglia, L.; Parodi, L. (Fiat, Turin (Italy). Sezione Energia Nucleare). pp 401-419 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The research and development program for the PEC reactor is described. The problems connected with test circuits, instrumentation, fuel element, and electromagnetic pumps are discussed. (INIS)

32306 DESIGN STUDIES FOR A 1000 MWe INTEGRATED FAST SODIUM REACTOR. Musso, B. (Progettazioni Mec-

caniche Nucleari, Genoa (Italy)). pp 525-539 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

Design studies for a 1000 MW(e) fast reactor prototype are described. Data and technical results are reported for a reactor charging machine and for a heat exchanger. A complete design program for the reactor core is also discussed. (INIS)

32307 ITALIAN PROGRAM RULE IN THE DEVELOPMENT OF THE FAST REACTORS. Pierantoni, F. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Programma Reattori Veloci). pp 254-263 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

A brief history of the Italian program for the development of fast nuclear reactors is presented, pointing out the connections with similar programs of other countries. Prospects and industrial developments in this field in Italy are also presented. (INIS)

32308 HEAVY COMPONENTS DEVELOPMENT FOR SODIUM PLANTS AT FRANCO TOSI. Radaelli, L. (Tosi (Franco) S.p.A., Legnano (Italy)). pp 471-478 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The organization and the resources of the Franco Tosi Company are briefly described. A general survey of the company activities in the sodium plants field is presented and a plan for the future is presented. (INIS)

32309 THE AGIP ACTIVITIES IN THE RESEARCH AND DEVELOPMENT PROGRAM FOR FAST REACTORS IN ITALY. Serafini, A. (AGIP Nucleare, Milan (Italy)). pp 505-524 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian)

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The AGIP R and D program for fast reactors is described. The activities include design of prototypes and facilities for testing, reactor charging machines, fuel elements, models, mechanical components, and sodium valves. (INIS)

32310 FRENCH EXPERIENCES IN FAST NEUTRON REACTORS. Vendryes, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France)). pp 281-290 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In French).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The French experience in the fast reactors field is reported. The Rapsodie development program and the Phenix characteristics are examined. The fuel cost and the fuel cycle problems are particularly discussed. The future development of the Phenix reactor into a 1200 MW(e) commercial reactor is also indicated. (INIS)

32311 STATE OF DEVELOPMENT AND PROSPECTS OF THERMAL BREEDING REACTORS. Zorzoli, G. B. (Centro Informazioni Studi Esperienze, Milan (Italy)). pp 239-253 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian)

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The economical and technical problems connected with the development of the thermal breeder reactor are examined and discussed. A comparative evaluation is made between the Molten-Salt Breeder Reactor and the Light Water Breeder Reactor. It is concluded that the prospects are not very promising for these types of reactor. (INIS)

32312 THERMALLY INSULATING CLOSING UPPER COVER FOR FAST-NEUTRON NUCLEAR REACTORS. Lemercier, G.; Schoulguine, P.; Trielli, J. (to CEA, 75- Paris (France)). French Patent 2,235,461/A/. 26 Jun 1973. 16p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

Description is given of a thermally insulating closing upper cover for fast neutron nuclear reactors. This cover comprises a suspended vessel open in its upper portion containing the reactor core and filled with a cooling liquid metal the free surface of which is surmounted with an inert gas atmosphere under the cover, the latter comprising a metal bed plate extending above the vessel liquid metal and supporting a thick layer of concrete in which is embedded a circuit for cooling said bed plate. Said cover is characterized in that the face thereof in contact with the inert gas atmosphere is lined with a thermally insulating structure sandwiched between the cover and a supporting metal sheet parallel with the bed plate. This can be applied to the protection of the cover against aerosols of the liquid metal contained in the vessel. (FR)

32313 THERMALLY INSULATING COATING IN PARTICULAR FOR THE UPPER COVER OF THE VESSEL OF A FAST NEUTRON NUCLEAR REACTOR. Lemercier, G. (to CEA, 75- Paris (France)). French Patent 2,235,329/A/. 26 Jun 1973. 13p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

This coating is constituted by a series of panels each of which comprises a padding of superimposed metal cloths or lattices parallel with the upper cover to be thermally insulated. The panels as a whole are enclosed in at least one metal casing fixed against the cover and whose bottoms which are parallel with the panels are constituted by sealing metal sheets applied against said panels; the casing lateral faces connecting these sealing sheets are constituted by at least two interengaged angle irons. This can be applied to liquid metal cooled reactors for protecting the cover against the vapors and aerosols of said cooling metal. (FR)

32314 ADAPTATION OF SOVIET EXPERIMENTAL FAST REACTOR BR-5 TO BR-10. Hermansky, B. Jad. Energ.; 19: No. 1, 29-31(Jan 1974). (In Czech).

A description is presented of the adaptation of fuel elements of the cooling system and of the biological shielding serving the modification of the Soviet experimental fast reactor BR-5 to BR-10. The basic specifications of the BR-10 reactor are given. During the adaptation, research was conducted into the long-term radiation effects on structural materials. Particular attention was focused on the volume changes in the reactor vessel, the inner central tube jacket and in the compensation cylinder, which is the principal element of accident protection. The results are reported of the calculation of the main physical characteristics of the BR-10 reactor and compared with the measured values. (Nuclear Sci. Abstr. Czech)

32315 NEUTRON SPECTROMETRY IN FAST REACTOR PHYSICS. Kazanskii, Yu. A.; Van'kov, A. A.; Inyutin, E. I. (Inst. of Physics and Nuclear Power, Obninsk, USSR). At. Energy Rev.; 13: No. 4, 807-920(Dec 1975).

The authors review work in reactor neutron spectrometry, considering the accuracy required in neutron spectrum measurements from the point of view of fast reactor physics, the method used in neutron spectrum measurements and the errors involved in such measurements. Methods for treating the experimental data and methods of neutron spectrum calculations are discussed briefly. Measured and calculated spectra are compared.

32316 UPPER COVER FOR CLOSING THE VESSEL OF A FAST NEUTRON NUCLEAR REACTOR. Jacquelin, R.; Lemercier, G.; Trielli, J. (to CEA, 75- Paris (France)). French Patent 2,235,460/A/. 26 Jun 1973. 9p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

Description is given of an upper cover for closing the vessel of a fast neutron nuclear reactor, the core of which is mounted in an open vessel containing cooling liquid metal surmounted with an inert gas atmosphere said cover comprising a horizontal metal bed-plate above the liquid-metal level. This cover is characterized in that it carries a thick layer of concrete in which is embedded a cooling circuit whereby the aerosols of the cooling metal condense on said bed plate thus forming a thermally insulating layer of solidified metal. This can be applied to high power reactors with large diametral dimensions. (FR)

32317 STATUS OF THE LIQUID METAL FAST BREEDER REACTOR PROGRAM. Flaherty, J. J. (USAEC, Washington, D. C.). pp 575-592 of Advanced Nuclear Reactors. Rome; CNEN (1974).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The status of the U. S. LMFBR program is examined. Design, construction, and economic aspects of the demonstration plant and the Fast Flux Test Facility are discussed. (INIS)

32318 STRATEGY, DESIGN BASIS, AND RESULTS OF THE CARBIDE PROGRAM FOR SNR. Karsten, G.; Muehling, G.; Plitz, H. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Technol.; 28: No. 2, 208-215(Feb 1976).

The carbide fuel which will be introduced into the SNR for the first time after 1980 will be helium bonded with a low linear heat rating and fuel density. This design appears to be the least problematic one for a medium burnup goal. The restriction to a moderate design arises to a certain extent from economical and safety reasons, but mainly can be attributed to uncertainties in extrapolation to a very high performance level. This can be demonstrated in a general discussion valid for both oxide and carbide. Due to the fact that the fuel elements of a large power plant with a peak burnup of 100 MWd/kg will undergo radiation damages, which cannot be demonstrated by experimental fuel pins in test (DFR, Rapsodie) or demonstration reactors (SNR, PFR, etc.) for the first generation, licensable maximum burnups will be in the range of 70 MWd/kg. It is impossible to perform tests outside the future large power plants with a relevant neutron dose-to-fuel burnup ratio. Therefore, in the German program a continuous development has been underway since 1968, in which separate medium burnups and neutron doses are demonstrated in test and demonstration reactors. In addition, the fuel fabrication process will be steadily improved in a pilot fabrication plant. (auth)

32319 ACTINIDES AND FISSION PRODUCTS DISTRIBUTION IN FAST BREEDER NITRIDE FUEL. Giacchetti, G.; Sari, C.; Walker, C. T. (EURATOM, Karlsruhe, Ger.). Nucl. Technol.; 28: No. 2, 216-225(Feb 1976).

The distribution of the actinides and the composition of metallic fission-product inclusions and oxide inclusions in a mixed-nitride fuel irradiated to 1.29 percent FIMA in a fast flux has been investigated using an electronprobe microanalyzer. Plutonium enrichment was found at open and healed cracks, and a significant decrease in plutonium concentration was measured in the region of the central void. Metallic inclusions were detected in a band at a radial position r/r_0 equals 0.7 to 0.8. The inclusions were of two types: intermetallic compounds of the form UMe_2 where Me equals ruthenium, rhodium, and palladium, and molybdenum-technetium alloys. Plutonium was absent in all inclusions examined. Oxide inclusions were observed in the outer part of the fuel at r/r_0 greater than 0.5. These were also of two types. The first contained approximately 5 wt percent plutonium and was situated in the interior of the grains. The second had a plutonium concentration of approximately 18 wt percent and was found at grain boundaries. The plutonium concentration of both types of inclusions was lower than the nominal concentration of the fuel matrix. During irradiation oxide inclusions were formed in the outer part of the fuel by the oxidation of sesquinitride precipitates. The limit of plutonium solubility in uranium sesquinitride is proposed to be approximately 5 wt percent.

32320 SODIUM IN-PILE LOOP EXPERIMENT ON DELAYED NEUTRON DETECTOR-, PRECIPITATOR-, AND COVER-GAS GAMMA-RAY SPECTROMETER-TYPE FUEL FAILURE DETECTION SYSTEMS. Sakai, E.; Katagiri, M.; Itoh, H. (Japan Atomic Energy Research Inst., Ibarakiken). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 363-374(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Performance of four different types of fuel failure detection systems has been studied using a sodium in-pile loop located in Japan Research Reactor No. 2. In the sodium in-pile loop, 8.5 liter sodium circulates through an irradiation section (500°C), a main cooler (400°C), an expansion tank (380°C), an electromagnetic pump, and a main heater at a flow rate of 3 liters/min. In the irradiation section, four metallic uranium (20 percent enriched) plates of a total amount of U-235 of 9.18g had been irradiated at a thermal neutron flux of 5.4×10^{10} n/cm^2 sec. A delayed neutron detector consisting of a BF_3 counter system in a graphite moderator (50 cm x 50 cm x 80 cm) detects delayed neutrons from fission products in the expansion tank. Helium cover gas over the sodium in the expansion tank carries gaseous fission products to a precipitator by which beta-rays from Rb-88 and Cs-138 collected on the precipitator wire are detected. The precipitator was modified to measure gamma-ray spectra from the wire using a Ge(Li) detector system for the nuclide identification. The helium gas is also guided into a gas reservoir whose gamma-ray spectra are analyzed by another Ge(Li) detector system. Construction and performance of these detection systems are described in detail and their detection sensitivities and response are compared.

32321 OVERVIEW OF FUEL HANDLING REQUIREMENTS AND SYSTEMS. Amorosi, A. (Argonne National Lab., IL); Matte, J. Conf. Remote Syst. Technol., Proc.; 23: 332-343 (1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

Basic considerations for the liquid-metal-cooled fast breeder reactor fuel handling system are discussed. Utility requirements are factored into the design parameters. Representative systems are included to allow comparison of different types of fuel handling systems. The characteristics of core handling schemes, as well as out-of-reactor fuel handling at the plant, are reviewed. (auth)

32322 CORE UNLOADING SCHEMES. Duffy, J. (Detroit Edison Co., MI); Hutter, E.; Pardini, J.; Lawroski, H. Conf. Remote Syst. Technol., Proc.; 23: 344-353(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The major factors to be considered in designing the in-vessel fuel handling systems and equipment for large [1200 MW(e)] LMFBR fast reactor power plants are discussed. Present arrangements used in existing reactors are described and the scaleup to accommodate 1200-MW(e) requirements is presented. Several alternative methods of in-vessel fuel handling are described. The impact on the sizes of components to handle the much larger and heavier fuel elements used in the 1200-MW(e) LMFBR reactors is emphasized. (auth)

32323 IN-PLANT FUEL HANDLING TRANSPORT AND STORAGE. Kaspic, W. A. (Argonne National Lab., IL). Conf. Remote Syst. Technol., Proc.; 23: 354-362(1972).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A survey was made of that element of the LMFBR fuel handling system design that deals exclusively with in-plant transport and storage. In this survey, four generalized methods of transport and storage are selected as representative of current transport concepts. Key aspects of the methods selected are evaluated, resulting in the implicit conclusion that reactor plant designs featuring a fixed exit port, integral transfer cell, and contiguous storage are most likely to have a higher plant availability because of reduced downtime for refueling. (auth)

32324 LMFBR SPENT FUEL AND NEW FUEL INSPECTION AND HANDLING. Youngquist, C. H. (Argonne National Lab., IL). Conf. Remote Syst. Technol., Proc.; 23: 363-369(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

If the hot cells used for inspection and preparation of liquid-metal fast breeder reactor fuel assemblies can be located so the fuel assemblies can be moved directly to and from the sodium-filled decay storage tank, the fuel handling problems can be simplified and a fuel handling machine may be eliminated. The hot cells can also serve as a transfer lock through the outer containment barrier, thereby permitting uninterrupted reactor operation during fuel transfer to and from the decay storage tank. (auth)

32325 SPENT AND FRESH FUEL SHIPPING CASK CONSIDERATIONS. Shappert, L. B. (Oak Ridge National Lab., TN); Unger, W. E.; Freedman, J. M. Conf. Remote Syst. Technol., Proc.; 23: 370-376(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A program to provide basic information for cask design and safety has been conducted for over ten years at Oak Ridge National Laboratory. Principal problem areas in liquid-metal fast breeder reactor (LMFBR) spent-fuel shipping casks are identified as heat transfer, structures and containment, criticality and shielding. Solutions in the problem areas, as well as the need for future work, are addressed by describing an LMFBR conceptual design cask. A new program, which is under way at Sandia Laboratories, Albuquerque, New Mexico, is aimed at producing technology useful to industry and government. Technologies are being developed in areas of hazards analysis, heat transfer, shielding, structures and containment, and spent-fuel characterization, substantiated by hot laboratory verification. Particular emphasis will be placed on establishing qualification tests based on accident experience. Handling requirements and limitations are noted throughout the paper.

32326 EXPERIENCE WITH FERMI FUEL HANDLING. Johnson, K. P. (Detroit Edison Co., MI). Conf. Remote Syst. Technol., Proc.; 23: 390-396(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

Fourteen years experience with fuel handling operations at the Enrico Fermi sodium-cooled reactor is summarized. Mechanisms exposed to 1000°F sodium are described with respect to removal, repairs, alterations, and return to service. Proposed improvements for future systems are discussed. (auth)

32327 CLINCH RIVER BREEDER REACTOR PROJECT FUEL HANDLING SYSTEM. Foster, K. W. (Atomics International, Canoga Park, CA). Conf. Remote Syst. Technol., Proc.; 23: 415-423(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The fuel handling system for the Clinch River breeder reactor project (CRBRP) is based primarily on existing technology, and in many respects follows the concepts developed for the Fast Flux Test Facility (FFTF). However, the use of recycled light-water reactor fuel requires special handling features for new fuel. Also, the direct removal of spent fuel from the reactor requires handling fuel assemblies with a decay power approaching 20 kW. Several unique system features assure that the annual refueling will be accomplished within the allotted 20 days. (auth)

32328 BRIEF DESCRIPTION OF LMFBR FUEL HANDLING SYSTEMS. Yevick, J. (Energy Research and Development Administration, Washington, DC); Warberg, H. S.; Lawroski, H. Conf. Remote Syst. Technol., Proc.; 23: 424-431(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The prominent features of fuel handling systems are summarized for operating and near-operating fast reactor power plants in the United States and foreign countries. The methods for removing fuel from the core, storing spent fuel in the primary tanks, and transporting the discharged fuel to spent-fuel handling cells are discussed. Emphasis in most reactor fuel handling systems has been placed on minimum shutdown time for refueling. (auth)

32329 ADVANCED FUEL HANDLING CONCEPT. Fromm, L. W. (Argonne National Lab., IL); Mathay, P. W. Conf. Remote Syst. Technol., Proc.; 23: 432-437(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A fuel handling system that keeps the spent-fuel assembly under sodium throughout the transfer operation from the core to the spent-fuel storage tank is described. A shielded transfer chamber containing a sodium-operated hydraulic motor to drive a push-pull chain with an attached fuel grapple is the mechanism for transferring the fuel assembly. Access to the core from the transfer chamber is provided by a dip pipe extended into the reactor sodium. A transfer arm carrier is used to accept the fuel assembly from the in-vessel fuel grapple and to move it directly to the dip pipe for removal. Access to the storage tank from the transfer chamber is provided by an exit pipe. The fuel handling system can be reversed to insert new fuel into the reactor core. (auth)

32330 EFFICIENCY OF THE PURIFICATION OF THE SODIUM COOLANT IN THE BOR-60 REACTOR FROM RADIOACTIVE IMPURITIES BY MEANS OF A COLD OXIDE TRAP. Polyakov, V. I.; Chechetkin, Yu. V. Sov. At. Energy (Engl. Transl.); 38: No. 3, 217-218(Mar 1975).

Translated from At. Energ.; 38: No. 3, 171-172(Mar 1975).

Sodium purification coefficients measured for a cold sodium oxide trap are presented. (DG)

Research, Test, and Experimental Reactors

Refer also to abstracts 29327, 32264, 32279, 32315, and 32441.

32331 (AEEW-R-1035) EXPERIMENTS WITH HYDROGEN-MODERATED CONTROL RODS IN ZEBRA ASSEMBLY 14. Ingram, G.; Burbidge, B. L. H.; Sanders, J. E. (UKAEA Reactor Group, Winfrith, Atomic Energy Establishment). Nov 1975. 35p. Dep. NTIS (US Sales Only) $4.00.

Zero-power studies of the performance of fast reactor control rods containing both absorber and hydrogenous moderator are described. The absorbers included boron, europium and gadolinium, the moderator being simulated by polypropylene. Reactivity worths significantly greater than those of conventional designs were achieved, the most promising arrangement comprising a boron-carbide annulus enclosing a moderating central region. No evidence for local power peaking was observed for such annular geometries.

32332 (HEDL-SA-796-S) EVALUATION OF ENDF/B-IV. Hardie, R. W.; Schenter, R. E.; Wilson, R. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 8 Jan 1975. 5p. (CONF-750607-50). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The recently released Version IV of ENDF/B was evaluated by calculating measured integral quantities for eighteen fast critical assemblies. The integral quantities investigated in this study were k/sub eff/, central reaction rate ratios, and central reactivity coefficients. In addition, to determine how ENDF/B-IV compares with earlier cross section data, calculations were also performed using Versions I, II, and III of ENDF/B and the Bondarenko cross section set. The evaluation indicates that ENDF/B-IV does an excellent job of predicting criticality for a wide range of critical assemblies. However, effort is still required to resolve differences between measured and calculated central reaction rate ratios and to resolve the fissile fuel central worth discrepancy.

32333 (HEDL-SA-1074S) FAST FLUX TEST FACILITY. A Slide Presentation. Herb, J. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. 87p. (CONF-751232-1). Dep. NTIS $5.00.

From meeting of the ASME; Portland, Oregon, United States of America (USA) (9 Dec 1975).

Seventy-eight black and white photographs are presented along with descriptive comments.

32334 (ILL-RA-1974(App.)) ANNEX TO THE ILL ANNUAL REPORT 1974. (Institut Max von Laue-Paul Langevin, 38-Grenoble (France)). 1974. 146p. INIS.

The volume deals with the scientific work carried out at ILL during 1974 using the HFR (Grenoble), cold and hot neutron sources. Theory, nuclear physics, pure crystals, crystalline and magnetic structures, liquids gases, amorphous substances, imperfections, biochemistry and physical chemistry are subject areas covered. (FR)

32335 (INIS-mf-1922) BRIEF DESCRIPTION OF THE SUBCRITICAL CAPITU. Andrade, V. M.; Paiano, S. (Instituto de Pesquisas Radioativas, Belo Horizonte (Brazil)). Mar 1974. 11p. (In Portuguese). INIS.

A brief description is given of the subcritical assembly CAPITU, to furnish the minimum elements required for a Security Report, and to serve as an introduction to users of the system. The following are described: moderator, experimental tank, fuel configuration, neutron sources, heavy water reserve, fuel bundle drying and storage tanks, and measurement instruments.

32336 (WARD-2171-54) FFTF SHIELDING DESIGN AND ANALYSIS. Summary Report. Rathbun, J. L. (ed.). (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jun 1975. Contract E(45-1)-2171. 806p. AT.

Information is included under the following headings: plant design, sources, shielding in-vessel, head compartment and operating deck shielding, plant neutron shielding, plant gamma ray shielding, fuel handling and maintenance shielding, and principal problems and resolutions. (JWR)

32337 (WARD-2171-56) FAST FLUX TEST FACILITY, Quarterly Progress Report for the Period Ending May 31, 1975. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1975. Contract E(45-1)-2171. 40p. AT.

Progress is reported under the following headings: reactor engineering, head compartment and shielding design, in-vessel handing machine and instrumentation and control systems, plant fluid systems and components, nuclear safety, and technology. (JWR)

32338 THE USE OF PLATE-LIKE FORK ABSORBERS IN THE REACTOR FRJ-1 (JUELICH). Muench, E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Nukleare Sicherheitsforschung); Thamm, G. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Forschungsreaktoren). Kerntechnik; 17: No. 5, 214-220(May 1975). (In German, English)

6 figs.; 6 refs.

The concept of plate-like fork absorbers, used successfully for many years in French research reactors of the swimming pool type, has been adopted for the 10 MW operation of the reactor FRJ-1 because it fulfills in an optimal manner in comparison with other variants the requirements for low flux density peaking in the absorber channel when the absorber is fully retracted, for a high reactivity effectiveness and for low space requirements in the special absorber/fuel element. The technical concept of the plate-like fork absorber version used in the FRJ-1 and the results of conventional and nuclear experimental investigations are described. The report on operating experience includes a detailed discussion of a failure caused by the swelling of an absorber blade. (DE)

32339 OPERATING EXPERIENCE WITH AN UHV SYSTEM IN THE VICINITY OF A FISSION-REACTOR CORE. Dobrozemsky, R. (Physics-Institute, Research Center Seibersdorf, Österreichische Studiengesellschaft für Atomenergie Ges. m. b. H., A-1082, Lenaugasse 10, Austria). J. Vac. Sci. Technol. 13: No. 1, 467-470 (Jan 1976).

For an experiment on neutron decay, an UHV system has been developed for a tangential beam-tube insert of the ASTRA reactor (peak

dose and flux density in the beam tube at 8 MW reactor power: 44 Mrad/h and 4×10^{12} n_{th}/cm^2 s, respectively). The central section of the beam-tube insert is evacuated mainly by means of a Zr–Al getter pump, giving an effective pumping speed of 40 l/s (N_2 equivalent) for the irradiated section. The main vacuum system is situated outside the reactor shielding and is evacuated by a pump combination (orbitron pump, titanium-sublimation pump, and sputter-ion pump); preevacuation is achieved by cryosorption pumps. During reactor operation the pressure can be kept $<10^{-5}$ Pa in the irradiated section of the beam-tube insert ($<10^{-7}$ Pa for the reactor switched off). The radiation-induced desorption (RID) yields mainly CO_2 and CO for the residual gas atmosphere. Experience from a three-year operation of this vacuum system is discussed in detail. (auth)

32340 RESEARCH REACTOR OPERATION AT THE NORILSK METALLURGICAL AND MINING COMBINE. Nikitin, V. N.; Pavlova, V. N.; Petrov, A. I.; Shchetinin, A. M. At. Energ. (USSR); 40: No. 1, 11-16(Jan 1976). (In Russian)

Industrial application of nuclear reactor PG-1M at a metallurgical and mining enterprise for activation analysis and radioisotopic research is described. A brief description of laboratory equipment, characteristics of the elaborated activation analysis procedures being used, and their place and significance in the analytical service of the enterprise, is given. Examples of radioisotopic investigations of metallurgical processes by means of radioactive isotopes are presented. The perspective for the growth of applied nuclear physics research methods at the enterprise are discussed and an attempt to evaluate the economic effectiveness of the work is made.

32341 REACTIVITY SURVEILLANCE EXPERIMENTS WITH THE ENGINEERING MOCK-UP CORE OF THE FAST FLUX TEST FACILITY REACTOR. Mihalczo, J. T.; Mathis, M. V.; Pare, V. K. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 59: No. 4, 350-368(Apr 1976).

An experiment was performed with a mock-up of the core of the Fast Flux Test Facility (FFTF) reactor to evaluate three reactivity measurement methods for application to liquid-metal fast breeder reactors (LMFBR): modified source multiplication measurements with the low-level flux monitor for refueling (35 dollars subcritical) of FFTF, noise analysis to 35 dollars subcritical, and inverse kinetics rod drop to 12 dollars subcritical. To investigate the spatial dependence of these measurement methods and to resolve discrepancies previously reported, detectors were placed in the core, reflector, and radial shield, and experimental data were collected with the reactivity at near delayed criticality to 35 dollars subcritical. Conclusions from this experiment are the following. Low-level flux monitors in the shield of the FFTF will be adequate for reactivity surveillance during refueling, using the modified source multiplication method calibrated near critical by an inverse kinetics rod drop measurement. The breakfrequency noise analysis method to -35 dollars with in-core detectors, the modified source multiplication method to -35 dollars, and inverse kinetics rod drop method to -12 dollars with detectors at all locations (corrected for changes in nuclear parameters) yielded the same reactivities within less than 5 percent. From reactor physics considerations, breakfrequency noise analysis with in-core detectors is best for monitoring reactivity down to full shutdown since it requires only a simple correction with reactivity that depends on global parameters of the system rather than a correction that depends on the value of the flux at a point or on the inherent source intensity, such as are required for the modified source multiplication method. However, for simple point kinetics interpretation of the results, the measurements must be made only with in-core detectors.

32342 ENRICHED URANIUM-LIGHT WATER REACTORS LATTICE STUDIES IN THE A.R.E. Fouad, H. Y. (Atomic Energy Establishment, Cairo (Egypt)). Kernenergie; 18: No. 8, 237-239(1975).

One of the main lines of reactor analysis in the A.R.E. revolves around an enriched uranium-light water research reactor and subcritical assembly. The physical aspects of above cell analysis are given. A simplified approach for criticality calculation gave a good agreement with experimental measurement conducted during reactor start-up. Further studies gave lattice characteristics for various volume ratios for which the subcritical assembly is operated. Comparisons with published results are made. Extensions and complementary plans are given.

32343 STUDIES OF THE PHYSICAL CHARACTERISTICS OF BOR-60 REACTOR. Kazachkovskii, O. O.; Alekseev, I. N.; Baranov, C. M.; Gadzhiev, G. I.; Gryazev, V. M.; Karapuba, Yu. M.; Krasgoyarov, N. V.; Lychagin, V. N.; Fofanov, V. S. pp 1-23 of Proceedings of the Indo-Soviet Seminar on Fast Reactors, Reactor Research Centre, Kalpakkam, December 6-8, 1972. Bombay; Department of Atomic Energy (1974).

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

Critical experiments have been performed during the start-up of the BOR-60 reactor and various physical characteristics of the reactor studied. Critical loading for various positions of the control rods was determined. The effect of replacing the operating fuel, element sub-assembly with the shielding sub-assembly and the worth of the safety control rod devices were also determined. The temperature, power, burnup and hydrodynamic effects of reactivity were investigated. The spatial distribution of the fission density was measured. The experimental results are given. The study shows that the method of calculation makes it possible to design this reactor and operate it successfully.

32344 DESTRUCTIVE BURN-UP DETERMINATION IN FUEL ELEMENTS OF THE VVR-S TYPE ROSSENDORF RESEARCH REACTOR. Hermann, A.; Baraniak, L.; Huebener, S.; Katzwinkel, I.; Legler, R. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Kernenergie; 18: No. 6, 157-162(1975). (In German).

Destructive determination of burn-up in two fuel elements from the first charge of the VVR-S type Rossendorf research reactor has been carried out for purposes of hot testing of the techniques and devices developed. Sampling was made at given points of the fuel elements, and the fuel matrix was selectively dissolved with 12 N HNO_3 leaving the Al cladding. The absolute content of the following components has been determined in the sample solutions: ^{137}Cs, ^{90}Sr, uranium. Burn-up has been calculated by means of the program ABBRA 1 and using a simple relation. Moreover, an independent value of burn-up has been obtained from mass spectroscopic isotopic analysis of uranium. The burn-up values obtained by these techniques are in good accordance with the burn-up distribution over fuel element height measured gamma-spectrometrically.

32345 ENERGY DISTRIBUTION OF NEUTRONS EMERGING FROM BR-10 REACTOR CHANNELS. Trykov, L. A.; Semenov, V. P.; Nikolaev, A. N. Sov. At. Energy (Engl. Transl.); 39: No. 1, 631-635(Jul 1975).

Translated from At. Energ.; 39: No. 1, 56-60(Jul 1975).

The neutron spectra and thermal flux from several channels in the BR-10 reactor were measured.

32346 USE OF PLUTONIUM IN HEAVY WATER MODERATED BOILING LIGHT WATER COOLED REACTOR. Takekoshi, T.; Sawai, S. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). pp 121-137 of Advanced Nuclear Reactors. Rome; CNEN (1974).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

Specific characteristics of FUGEN type reactors are discussed and the use of plutonium is evaluated considering the power cost implications. The reactor safety features and the large testing facilities available are described, reporting also the reactor design data. (INIS).

32347 THE CIRENE PROTOTYPE. Broggiato, A. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)); Casagrande, I. (Centro Informazioni Studi Esperienze, Milan (Italy)); Pedretti, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). pp 39-57 of Advanced Nuclear Reactors. Rome; CNEN (1974). (In Italian).

From proceedings of nuclear energy days of Milan organized by FAST with the cooperation of CNEN and ENEL; Milan, Italy (14 Dec 1972). (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).

The main characteristics of the CIRENE reactor prototype are presented and discussed, looking in detail into the fuel element design, the cooling system and the safety system. The role of a reactor of such type is also discussed and an up-to-date status of the project is presented. (INIS)

32348 NEUTRON RADIOGRAPHY OF A GRID-TYPE SUBASSEMBLY. Taylor, D. S.; Harrison, L. J.; White, J. R. (Argonne National Lab., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 190-196(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The examination and performance evaluation of grid-type subassemblies irradiated in EBR-II required neutron radiography prior to disassembly. This operation required that the subassembly be shielded, contained, and cooled in a package small enough to allow location of the radiography foil close to the grid detail for sharp resolution of the structure. A sealed can with static helium

as the heat transfer medium provided satisfactory containment and cooling for the subassemblies; the can contained cadmium targets for precise rotational alignment of subassemblies during radiography. (auth)

32349 DESIGN AND PROCUREMENT REPORT FOR THE FFTF FUEL HANDLING SYSTEMS BOTTOM-LOADING TRANSFER CASK. Keaney, S. T. (Aerojet Manufacturing Co., Fullerton, CA). Conf. Remote Syst. Technol., Proc.; 23: 281-288(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The Fast Flux Test Facility (FFTF) bottom-loading transfer cask (BLTC) system is designed to provide ex-vessel fuel transfers of irradiated reactor components between the reactor containment building and the LMFBR shipping cask in the reactor service building. This system is being procured from National Lead Industries, Wilmington, Delaware, under management of Aerojet Manufacturing Company. (auth)

32350 DESIGN OF THE HIGH-TEMPERATURE SODIUM FACILITY LARGE-COMPONENT HANDLING SYSTEM. Tome, R. L.; Matsuo, R.; Woodfill, W. (Aerojet Manufacturing Co., Fullerton, CA). Conf. Remote Syst. Technol., Proc.; 23: 295-302(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The High-Temperature Sodium Facility (HTSF) supports the Fast Flux Test Facility (FFTF) development and testing within the U. S. Energy Research and Development Administration's liquid-metal fast breeder reactor (LMFBR) program. Equipment is required for safe and reliable removal, transfer, and installation of large nonradioactive, sodium-wetted components within the HTSF. Use of this equipment during HTSF operations will provide valuable experience which will be utilized to design the FFTF radioactive large-component handling equipment. (auth)

32351 DESIGN OF THE FAST FLUX TEST FACILITY MULTIPURPOSE MAINTENANCE ENCLOSURE SYSTEM. O'Bannon, W. B.; Allen, R. A.; Ward, D. O. (Aerojet Manufacturing Co., Fullerton, CA). Conf. Remote Syst. Technol., Proc.; 23: 303-308(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

Operation and maintenance of the Fast Flux Test Facility (FFTF) within the U. S. Energy Research and Development Administration (ERDA) liquid-metal fast breeder reactor (LMFBR) program require equipment to handle small sodium-wetted components and tools. The multipurpose maintenance enclosure system (MES) will provide a safe, reliable system to remove, transfer, and install components within the FFTF. (auth)

32352 CORE-COMPONENT DISASSEMBLY/REASSEMBLY STATION: FOR USE IN THE FFTF EXAMINATION/MAINTENANCE (IEM) CELL. Morris, E. J. (Aerojet Manufacturing Co., Fullerton, DA). Conf. Remote Syst. Technol., Proc.; 23: 309-315(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The core-component disassembly/reassembly station is designed to provide a safe, reliable means to remotely disassemble, reassemble, and examine nuclear-irradiated fuels, materials, and components under controlled environmental conditions. The mobile assembly is to be remotely operated from a gallery control console at the interim examination maintenance cell of the Fast Flux Test Facility in Richland, Washington, and will provide a means to accomplish the cell disassembly and reassembly activities required in support of the liquid-metal fast breeder program activity. (auth)

32353 EXPERIENCE WITH EBR-II FUEL HANDLING. Hutter, E. (Argonne National Lab., IL). Conf. Remote Syst. Technol., Proc.; 23: 379-389(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

The operating experience of EBR-II fuel handling is discussed. Over 15,000 subassemblies have been handled over a period of some 14 years. Removal and reinstallation of the transfer arm and the gripper were successfully accomplished. Improvements of sensing systems for remote operation have increased the reliability of the fuel handling process. Maintenance has been required occasionally due to normal sodium buildup. Experience has shown that simple mechanisms with adequate clearances are most successful. (auth)

32354 FFTF FUEL HANDLING SYSTEM FEATURES AND EXPERIENCE. Hornberger, D. M.; Boyd, C. L. (Westinghouse Hanford Co., Richland, WA). Conf. Remote Syst. Technol., Proc.; 23: 397-414(1975)

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

Plant design features of the Fast Flux Test Facility (FFTF) are summarized to provide a background for requirements imposed on the fuel handling system. Normal handling sequences for core components and test assemblies are described, and features of the fuel handling facilities and machines are detailed. System control and inventory means are discussed in relation to interfaces with machines and operating procedures. Feature tests and performance tests necessary to establish design capability are identified, and experience to date is discussed. (auth)

32355 IN-PILE GAMMA-RAY SPECTROMETRY TO FOLLOW OSIRIS IRRADIATIONS. Farny, G. (CEN de Saclay, Gif-Sur-Yvette, France); Destot, M.; Texier, D.; Faugere, J. L.; Mouchnino, M. Nucl. Technol.; 29: No. 1, 113-123(Apr 1976).

A description is given of a gamma-ray spectrometry facility located in the immediate proximity of the OSIRIS reactor core. This device is used to examine nuclear fuel elements in loop or rig throughout the period of irradiation, with no more than a few minutes required to transfer the fuel from the irradiation point to the measurement bench. This internal reactor gamma-ray spectrometry device of original design eliminates corrections for radioactivity decrease and avoids any risk of overlooking relevant data.

32356 LIQUID LEVEL DETECTOR FOR REACTOR ENVIRONMENTS. Goodrich, L. D.; Arave, A. E. (Idaho National Engineering Lab., Idaho Falls, ID). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 386-390(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A conductivity-sensitive liquid level detector has been designed for the pressurized water reactor environment of the Loss-of-Fluid Test (LOFT) reactor at the Idaho National Engineering Laboratory. Test results indicate the detector is not only capable of indicating liquid level, but also oscillatory behavior in the two-phase fluid. Test data are presented along with a brief description of the detector design.

32357 BROOKHAVEN REACTOR EXPERIMENT CONTROL FACILITY: A DISTRIBUTED FUNCTION COMPUTER NETWORK. Dimmler, D. G.; Greenlaw, N.; Kelley, M. A.; Potter, D. W.; Rankowitz, S.; Stubblefield, F. W. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 398-405 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A computer network for real-time data acquisition, monitoring and control of a series of experiments at the Brookhaven High Flux Beam Reactor has been developed and has been set into routine operation. This Reactor Experiment Control Facility presently services nine neutron spectrometers and one x-ray diffractometer. Several additional experiment connections are in progress. The architecture of the facility is based on a distributed function network concept. A statement of implementation and results is presented.

32358 COLD NEUTRON GENERATOR WITH NATURAL CIRCULATION OF THE REFRIGERANT. Chudinov, V. G.; Goshchitskii, B. N.; Gusev, V. V.; Konstantinov, L. V.; Polosukhin, B. G.; Sidorov, S. K. Sov. At. Energy (Engl. Transl.); 38: No. 3, 234-237(Mar 1975).

Translated from At. Energ.; 38: No. 3, 181-183(Mar 1975).

The fraction of cold neutrons ($E < 0.005$ eV) in the normal beams of research reactors, consist as a rule of 1 to 1.5% of the total number of neutrons in the beam. One of the methods of increasing the intensity of cold neutrons is by cooling the moderator, from which the neutrons enter the experimental channel, to a quite low temperature. This involves the necessity of removing the large quantity of heat released in the structural elements of the facility and moderator due to radiation heating. A cold neutron generator is described in which the moderator is cooled by the natural circulation of the refrigerant (high-purity nitrogen) in a closed loop, and the results of tests are presented. Ethyl alcohol is used as the moderator with a cooling layer 30 mm thick. (auth)

32359 VVR-S REACTOR AS A SOURCE OF NEUTRONS. Pittermann, P. (Inst. of Nuclear Research, Rez, Czech.). Radioisotopy; 14: No. 3, 404-413(Jun 1973). (In Czech)

Irradiation possibilities are reported of the VVR-S reactor. The measured values of thermal, ipithermal and fast neutron flux densities in the respective irradiation channels of the reactor are presented. Also discussed are the problems of heat generation in the irradiated sample, of the effect of core configuration on neutron flux density distribution, of changes in neutron flux density with changes in the gradient of neutron flux density,

of monitoring dose rates, of sample geometry, etc. Information is also presented on the organization of irradiation services and the price thereof. (Nuclear Sci. Abstr. Czech.)

Production and Materials Testing and Processing Reactors

32360 (EUR-5312) HIGH FLUX MATERIALS TESTING REACTOR (HFR) PETTEN. Annual Report 1973. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center). Dec 1974. 92p. INIS.

The work performed in 1973 under the HFR program is outlined. The HFR program comprises the operation of the Petten High Flux Reactor and the design, construction and operation of experiments. The reactor was used for short-time irradiations, radioisotope production and beamtube experiments. During the year 1973, the reactor availability was increased from 40% (cycle 73.01) to 55% (cycle 73.09) toxin, a reference number of 15 in-tank channels, 12 poolside facility positions, and 10 horizontal beamholes. Reactor availability is expected to reach between 65 and 85% in the following years. HFR Petten has developed its own field on competences and special irradiation techniques: creep facilities for fissile material and for graphite, fast reactor fuel transient experiments, light water reactor fuel capsules for steady state and transient conditions, large size HFR component rigs, and other specially instrumented "tailor-made" facilities for particular investigations.

Propulsion and Package Reactors

Refer also to abstracts 32273 and 32372.

32361 (FRNC-CONF-128) OPTIMIZATION OF THE FUEL CYCLE. Benveniste, E. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France)). 29 Apr 1975. 12p. (In French). INIS.

From international conference on nuclear merchant ship propulsion; New York, USA (18 May 1975).

Fossil fuel offers certain advantages for the driving of merchant ships. So does nuclear fuel, but it is cumbersome to use. The need for periodic rearrangement in specially equipped ports is a serious handicap. One solution is to refuel without the help of land-based equipment. Under these conditions it is possible to optimize the fuel cycle cost by defining the core of the nuclear heater and its type of management independently of the ship's piloting obligations. (FR)

32362 (INIS-mf-) COMMERCIAL NUCLEAR SHIPS. Poirier d'Ange d'Orsay, P.; Andrieu, J. L. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France)). 1975. 14p. (In French). INIS.

From colloquium on nuclear law and law of the sea; Paris, France (12 Jun 1975).

Colloquium organized by the Centre d'Etudes et de Recherches de Droit International and the Centre d'Etudes du Droit de l'Energie Atomique.

Following discussion of the arguments in favour of nuclear merchant ships and development of nuclear ship propulsion, the rentability of nuclear ships is dealt with in a comparative study with conventional ships regarding fuel costs, investments and environmental impact. The structure and components of a nuclear ship are described, with emphasis on its safety equipment. The problem of insurance is examined, particularly in connection with the difficulty in applying insurance for liability due to the present uncertainties of the legal position at international level. French legislation does not solve the problem of visiting foreign nuclear ships. The risk concept at operational, design and construction stages is also discussed. Unresolved difficulties, especially concerning the construction of nuclear ships, uncertainties in competitivity analyses between conventional and nuclear propulsion, and implementation of specific and complete legislation on nuclear ships are also mentioned, particularly in the context of their visits to ports. (FR)

32363 (INIS-mf-) PASSAGE OF NUCLEAR POWERED SHIPS IN TERRITORIAL WATERS AND THEIR STAY IN HARBOURS. Lucchini, L.; Voelckel, M. (Orleans Univ., 45 (France)). 1975. 30p. (In French). INIS.

From colloquium on nuclear law and law of the sea; Paris, France (12 Jun 1975).

Colloquium organized by the Centre d'Etudes et de Recherches de Droit International and the Centre d'Etudes du Droit de l'Energie Atomique.

The specificity of rules governing entry of nuclear ships in the territorial waters of a State and their liability are reviewed. The concept of innocent passage prevailing for navigation in territorial waters is examined as are the protective measures taken by the Host State, in particular the prior authorization characterizing that State's discretionary powers of acceptance or refusal to admit the nuclear ship and the control over it. Liability rules and the nature of liability are analyzed on the basis of agreements on the Savannah and the Otto Hahn. The importance of State intervention is demonstrated in its relationship with the operator particularly regarding control of operation and financial assistance. Also mentioned is liability for breach of the rules of procedure laid down in bilateral agreements, and in this context, a study is made of the rules of conduct for nuclear ships in territorial waters set out in the Savannah and Otto Hahn agreements. The liability of the coastal State is reviewed from the viewpoint of its grounds and possibilities of extension, given the development of nuclear navigation and the importance attached to protection against marine environmental pollution. (FR)

32364 (INIS-mf-) THE 1962 BRUSSELS CONVENTION ON THIRD PARTY LIABILITY AND THE OTTO HAHN AGREEMENTS. Boulanger, W. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany)). 1975. 11p. (In French). INIS.

From colloquium on nuclear law and law of the sea; Paris, France (12 Jun 1975).

Colloquium organized by the Centre d'Etudes et de Recherches de Droit International and the Centre d'Etudes du Droit de l'Energie Atomique.

The 1962 Brussels Convention on the liability of operators of nuclear ships is discussed. The provisions of the Convention conform to a great extent to the provisions of the Conventions applicable to land-based nuclear installations. Particular emphasis is given to the provisions on the measures to be taken for enforcing judgments and payment of compensation. The visiting agreements of the Federal Republic of Germany to enable utilisation of the nuclear cargo ship Otto Hahn are discussed, together with the exchange of Notes permitting visits of the Otto Hahn before entry into force of a formal agreement. Mention is made of the difference in ceiling of the liability laid down by the German Atomic Energy Act and that of the Brussels Convention. A study is made of the influence of the Convention on national laws. (FR)

32365 (N-75-16355) VISIBLE SPECTRAL POWER EMITTED FROM A LASER PRODUCED URANIUM PLASMA. Williams, M. D.; Jalufka, N. W. (National Aeronautics and Space Administration, Langley Station, Va. (USA). Langley Research Center). Jan 1975. 10p. (NASA-TM-X-72626). NTIS $3.25.

The development of plasma-core nuclear reactors for advanced terrestrial and space-power sources is researched. Experimental measurements of the intensity and the spectral distribution of radiation from a nonfissioning uranium plasma are reported. (STAR)

32366 NUCLEAR ENERGY SOURCES FOR OFFSHORE PETROLEUM PROSPECTING. Devin, B.; Mabile, M. Aust. Chem. Eng.; 16: No. 8, 7-10(Aug 1975).

A discussion is given of the application of a navalised version of a conventional nuclear reactor and of a thermoelectronic reactor to offshore petroleum prospection. (AT)

32367 BERYLLIUM REFLECTED CAVITY REACTOR FOR UF6 CRITICAL EXPERIMENTS. Jarvis, G. A.; Bernard, W.; Helmick, H. H.; White, R. AIAA Paper 75-1260. Anaheim, CA; American Institute of Aeronautics and Astronautics (1975). 8p.

From 11th American Institute of Aeronautics and Astronautics and Society of Automotive Engineers propulsion conference; Anaheim, California (USA) (29 Sep 1975).

Experiments and theoretical studies are being conducted for NASA on critical assemblies with one-meter diam by one-meter long low-density cores surrounded by a thick beryllium reflector. These assemblies make extensive use of existing nuclear propulsion reactor components, facilities, and instrumentation. Due to excessive porosity in the reflector, the initial critical mass was 19 kg U (93.2). Addition of a 17-cm-thick by 89-cm-diam beryllium flux trap in the cavity reduced the critical mass to 7 kg when all the uranium was in the zone just outside the flux trap. A mockup aluminum UF6 container was placed inside the flux trap and fueled with uranium-graphite elements. Fission distributions and reactivity worths of fuel and structural materials are available. These results will be used to guide the design of a prototype plasma core reactor which will test energy removal by optical radiation. (IAA)

32368 N_2O_4 AS WORKING FLUID OF SPACE POWER INSTALLATIONS. Popyrin, L. S.; Starostenko, N. N.; Starostenko, V. I. (Sibirsk Power Engineering Inst., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 53-57(1975). (In Russian)

A thermodynamic cycle study is made for a nuclear cosmos power supply with N_2O_4 as heat and mass carrier. It is shown that the efficiency of this cycle approaches the efficiency of the gas–liquid cycle on the ideal mass carrier.

Reactor Safety and Environmental Aspects

Refer also to abstracts 29115, 29132, 29140, 29164, and 32568.

32369 (AI-ERDA-13148) NUCLEAR SAFETY CHARACTERIZATION OF SODIUM FIRES AND FAST REACTOR FISSION PRODUCTS. Quarterly Technical Progress Report, January–March 1975. (Atomics International Div., Canoga Park, Calif. (USA)). 15 May 1975. Contract AT(04-3)-824. 25p. Dep. NTIS $4.00.

Progress is reported in the areas of sodium splash dispersal, SOMIX code development, HCDA aerosol source term, aerosol leakage, fuel and fission product release from burning sodium, and high temperature properties of fuel mixtures. (JWR)

32370 (BMFT-RS-78A) SAFETY RELATED RESEARCH PROGRAM: CONDENSATION AND BLOWDOWN EXPERIMENTS. Final Report. Sobottka, H. (Comp.). (Kraftwerk Union A. G., Erlangen (F. R. Germany). Reaktortechnik). Jun 1975. 122p. (In German). Dep. NTIS (US Sales Only) $5.50.

BWR pressure relief system tests are described and interpreted. Included are free-blowing tests with the perforated tube nozzle at the test stand of Mannheim power station and at the model test stand of Grosswelzheim, processes at free-blowing and free-blowing pressures with the perforated tube nozzle, and simulation of air-bubble-oscillations to prove a calculation model. Tests for the suppression system included finding out the transverse powers at the vent pipes and finding out the maximum height and velocity of the water swell.

32371 (CENPD-185-A) CLAD RUPTURE BEHAVIOR. LOCA Rupture Behavior of 16 x 16 Zircaloy Cladding. Franklin, D. G.; Kneppel, D. S. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Nov 1975. 30p. Combustion Engineering Inc., Windsor, CT.

The experiments and the analysis of the experimental results on fuel cladding of system-80 16 x 16 assemblies subjected to a temperature ramp similar to that postulated for a loss-of-coolant accident are described.

32372 (COO-2571-3) IMPROVEMENT AND VERIFICATION OF FAST REACTOR SAFETY ANALYSIS TECHNIQUES. Progress Report, September 1, 1975–November 31, 1975. Jackson, J. F. (Brigham Young Univ., Provo, Utah (USA)). 1975. Contract AT(11-1)-2571. 14p. Dep. NTIS $3.50.

A number of improvements and refinements have been made to the VENUS-II analysis of the KIWI-TNT experiment. The final calculations for this study are now being performed. Areas of difference that appeared during the initial VENUS-II/PAD intercomparison study have been investigated and largely resolved. In particular, the treatment of the energy-of-vaporization was examined and found not to have a significant effect on the calculated temperatures. The next round of comparison calculations are currently underway. A study aimed at comparing and evaluating different methods of characterizing work-energy or damage-potential of core-disruptive accidents has been initiated.

32373 (FRRSR-8) ADAPTATION OF SIRENE CODE TO STUDY OF ACCIDENTAL TRANSIENTS IN PRESSURIZED WATER REACTORS (PWR). Merle, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). May 1975. Translation of SETS-69. 18p. Dep. NTIS $3.50.

Work performed under United States Nuclear Regulatory Commission Light Water Reactor Safety Technical Exchange Program.

To analyze the integrity of the cladding and fuel during transients resulting from a power plant malfunction, it is necessary to know the core's thermal hydraulic behavior under such conditions. However since such an analysis requires a fine representation of the core, it cannot be made independently of interactions between the core and the different components of the primary and secondary loops. Such an ambitious model demands a degree of machine time and congestion that make it patently undesirable to respond simultaneously to these two considerations. Hence the procedure adopted consists in: (1) Making a comprehensive determination of changes in the status of the primary fluid and nuclear power by using code describing the overall transient behavior of the core and its environment (the primary circuit and possibly the secondary); and (2) Employing the results thus obtained in a second computational code capable of accounting for flux spatial distributions and mass and energy transfers between assemblies and channels so as to complete the thermal hydraulic analysis of the core and evaluate particularly the evolution of the DNB in the hot assembly.

32374 (FRRSR-11) INSTRUMENTATION USED IN THE HEAT TRANSFER LABORATORY OF GRENOBLE FOR EXPERIMENTS RELATED TO LIGHT WATER REACTORS. Courtaud, M.; Delhaye, J. M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). Sep 1975. 9p. Dep. NTIS (US Sales Only) $3.50.

Work performed under United States Nuclear Regulatory Commission Light Water Reactor Safety Technical Exchange Program.

A review of the instrumentation used in different experiments performed for light water reactor studies either in steady state or transient conditions is presented. Some local measurement techniques which have been developed with view to a more thorough understanding of two phase flow are also described.

32375 (GA-A-13763) STATUS OF SAFETY-RELATED QUALIFICATION AND DESIGN VERIFICATION AND SUPPORT PROGRAMS IN SUPPORT OF HTGR PSARs. Biannual Report for Period Ending July 31, 1975. (General Atomic Co., San Diego, Calif. (USA)). 15 Jan 1976. 119p. (GA-LTR-103). General Atomic Co., San Diego, CA.

Progress is reported for the following activities: seismic program, test of core support posts, primary coolant moisture monitor testing, control and orificing assembly tests, core auxiliary cooling system tests, plant protection system electronic modules, and main helium circulator overspeed protection test. (JWR)

32376 (INIS-mf-1774) PROCEEDINGS OF THE BRITISH COLUMBIA PUBLIC FORUM: NUCLEAR POWER. (Government of British Columbia, Victoria (Canada)). 1974. 91p. INIS.

From British Columbia public forum: nuclear power; Vancouver, British Columbia, Canada (1 Dec 1973).

Proceedings of a public debate on nuclear power are presented. A panel of invited experts presented talks on the pro and con aspects of nuclear power in light of reactor safety, radiation hazards and protection, and conservation measures. Following the prepared presentations, questions from the audience were accomodated. Results of a questionnaire distributed to the audience are also presented. The purpose of the forum was to inform the public on nuclear power to further public participation in matters involving choice of future power systems for that province.

32377 (INIS-mf-1863, pp 156-173) INSTITUTT FOR ATOMENERGI. 1975. (In Norwegian).

In annual report 1974. (Norges Teknisk-Naturvitenskapelige Forskningsraad, Kjeller. NORSAR).

The program of the Institutt for Atomenergi (IFA) includes work on the safety and reliability of nuclear power plants, process control and instrumentation, fuel management and technology, isotope production and applications, process chemistry and analysis, radwaste treatment, fundamental research in crystallography, and education. Activities in these fields in 1974 are described, mainly briefly, but with more detail on the fuel testing program at the Halden Reactor Project.

32378 (INIS-mf-1874) PRE-PROJECT OF NORMS TO MAINTAIN AS LOW AS PRACTICABLE THE ACTIVITY LEVEL OF RADIOACTIVE RESIDUES IN EFFLUENTS FROM LIGHT-WATER-COOLED NUCLEAR POWER REACTORS, RELEASED TO UNRESTRICTED AREAS. Grimberg, M. (Comissao Nacional de Energia Nuclear, Rio de Janeiro (Brazil). Departamento de Reactores). Aug 1974. 17p. (In Portuguese). INIS.

The Brazilian National Nuclear Energy Commission (CNEN), in its Licensing Rules for Nuclear Power Reactors (CNEN's Resolution 6/72) has subscribed to the general principle that, within established radiation protection guides (CNEN's Resolution 6/73), radiation exposures to the public should be kept "as low as practicable". Based on the adoption of Appendix I by USAEC (Docket No. RM-50-2), these proposed rules would provide numerical guidance on design objectives and on limiting conditions for operation, for light-water-cooled nuclear power reactors to meet the CNEN's requirement that radioactive material in effluents released to unrestricted areas to be kept "as low as practicable".

32379 (KFK-2158) DETECTION OF OSCILLATORY COMPONENTS IN NOISE SIGNALS AND ITS APPLICATION TO FAST DETECTION OF SODIUM BOILING IN LMFBR'S. Ehrhardt, J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Schneller Brueter; Karls-

ruhe Univ. (TH) (F. R. Germany). Fakultaet fuer Maschinenbau). Sep 1975. 165p. (In German). INIS.

39 figs.; 6 tabs.; 26 refs.

A new detection system for the fast detection of suddenly appearing peaks in the frequency spectra of noise signals is presented. The prototype of a compact detection unit was developed which continuously computes the power spectral density (PSD) of noise signals and simultaneously supervises the PSD for peaks in the relevant frequency range. The detection method is not affected by the frequency dependance of the PSD and is applicable to any noise signal. General criteria were developed to enable the determination of the optimal detection system and its sensitivity. The detection criteria are applicable to all noise signals with approximately normally distributed amplitudes. Theoretical results were confirmed in a number of experiments; special experimental and theoretical parameter studies were done for the optimal detection of sodium boiling in LMFBR's. Computations based on these results showed that local and integral sodium boiling can be detected in a wide core range of SNR 300 by observing fluctuations of the neutron flux. (DE)

32380 (LA-6209-SR) FISSION PRODUCT DECAY HEAT STUDIES OF DECEMBER 15, 1975. Yarnell, J. L.; Bendt, P.J. (Los Alamos Scientific Lab., N. Mex. (USA)). 26 Feb 1976. Contract W-7405-Eng-36. 10p. Dep. NTIS $4.50.

The purpose of the project described is to study fission product decay heating rates, with emphasis on short decay times. Isothermal calorimetry is used to perform benchmark experiments for decay times between 20 seconds and 2000 seconds with an absolute accuracy of better than 5 percent. Experiments are being done with ^{235}U and will be done eventually with ^{239}Pu. Thermal neutron spectra are used for the irradiations. The project was initiated in July 1974. Final results for ^{235}U are expected by 6-30-76, and for ^{239}Pu by 1-1-77. Final reports for each task will follow the final data by 3 months. The work done to date is described together with the status of the final experimental configuration.

32381 (NP-20800-P1,P2) ENERGY PARKS AND THE COMMONWEALTH OF PENNSYLVANIA: ISSUES AND RECOMMENDATIONS. Volume I. Summary. Volume 2. Appendices. Knight, C. G.; Latham, R. J.; Witzig, W. F.; Wolgemuth, C. H. (Pennsylvania State Univ., University Park (USA). Center for the Study of Environmental Policy). Jul 1975. 329p. Pennsylvania State Univ., University Park (Vols. 1 and 2 $20.00).

As proposed for the Commonwealth of Pennsylvania, an energy park will be an agglomeration of power plants, both nuclear and coal-fired, with associated support facilities. This report defines a comprehensive set of questions and key issues that must be addressed in the formulation of a position on the energy park concept. A definitive quantitative or qualitative evaluation of the concept is not within the scope of this report, but rather this effort reviews the dimensionality of the problem and recommends an action plan for Pennsylvania. (JWR)

32382 (NU-2512-7) LIQUID-LIQUID SURFACE IMPACTION. Technical Progress Report, January 1, 1975-December 1, 1975. Bankoff, S. G. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Chemical Engineering). 1975. Contract AT(11-1)-2512. 6p. Dep. NTIS $3.50.

The critical Weber number for coalescence, when a droplet of Freon-22 or pentane falls on a pool of hot (80-180°C) silicone oil or glycerine, has been determined as a function of pool temperature and droplet size. Using this information, a splash theory for local propagation of a vapor explosion has been formulated, which agrees with intermediate-scale peak pressure data of Henry, et al. A hydrodynamic theory has been constructed for the minimum thickness of the gas film in the approach phase. The Board-Hall theory for fuel-contact detonation waves has been modified to take into account the presence of a swarm of drops, rather than a single drop. It is shown that the required shock wave peak pressures for droplet breakup is now approximately 10^5 bar, which makes the existence of a steady-state Chapman-Jouget wave highly unlikely.

32383 (ORNL/NSIC-121) REACTOR OPERATING EXPERIENCES, 1972-1974. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 232p. Dep. NTIS $15.00.

Safety-related incidents which occurred at reactor facilities between January 1972 and July 1974 are compiled.

32384 (ORNL/TM-5240) QUARTERLY PROGRESS REPORT ON BLOWDOWN HEAT TRANSFER PROGRAM FOR OCTOBER-DECEMBER 1975. Thomas, D. G.; Hedrick, R. A. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 76p. Dep. NTIS $6.00.

Progress is briefly reported for the following activities: two-phase flow instrumentation studies, forced-convection test facility operation, thermal-hydraulic test facility operation and instrumentation, and heater rod procurement and development. (JWR)

32385 (ORNL/TM-5248) QUARTERLY PROGRESS REPORT ON THE ZIRCONIUM METAL-WATER OXIDATION KINETICS PROGRAM SPONSORED BY THE NRC DIVISION OF REACTOR SAFETY RESEARCH FOR OCTOBER-DECEMBER 1975. Cathcart, J. V. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 35p. Dep. NTIS $5.00.

The experimental phase of the study of the diffusivity of oxygen in beta-Zircaloy between 900 and 1500°C (1652-2732°F) is essentially complete. No differences between chemical and tracer diffusivities were observed, and between 1000 and 1500°C (1832-2732°F) the combined data set could be represented by D equals 2.48×10^{-2} exp (-28200/RT) cm^2/sec. The forty specimens (from a standard batch of Zircaloy tubing) required to define isothermal oxidation rate curves at 900, 1000, 1100, and 1300°C (1652, 1832, 2012, and 2372°F) have been oxidized in the MiniZWOK apparatus and are undergoing metallographic examination. Oxidation rate data obtained at 900 and 1000°C (1652-1832°F) in the MaxiZWOK apparatus are presented, and the procedures following in evaluating and correlating such data are described in detail.

32386 (ORNL/TM-5255) QUARTERLY PROGRESS REPORT ON HIGH-TEMPERATURE GAS-COOLED REACTOR SAFETY STUDIES SPONSORED BY THE NRC DIVISION OF REACTOR SAFETY RESEARCH FOR OCTOBER-DECEMBER 1975. Sanders, J. P. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 19p. Dep. NTIS $5.00.

Research progress is briefly reported for the following tasks: reheater and steam generator model development, development of the nuclear steam supply system simulation code, core simulation for emergency cooling analysis, core auxiliary cooling system model development, and computer code implementation.

32387 (PB-240612) REPORT REGARDING THE EXXON NUCLEAR COMPANY EMERGENCY CORE COOLING SYSTEM NON-JET-PUMP-BWR FUEL HEATUP MODEL. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Nuclear Reactor Regulation). 6 Mar 1975. 50p. (NUREG-75/016). NTIS $3.75.

The Nuclear Regulatory Commission staff has reviewed the Exxon Nuclear Company's topical report describing their new Emergency Core Cooling System Non-Jet-Pump BWR Fuel Heatup Model (ECCS-NJP-BWR-FHM). The Exxon model, which is limited to analytical techniques used to predict the response of fuel bundles to a loss-of-coolant accident, was developed to conform to the applicable requirements of 10 CFR 50, Appendix K. The staff report evaluates how the model might be used in conjunction with other previously approved codes and information supplied by the licensee to form an ECCS-Evaluation model for NJP-BWR's. The report also presents NRC staff conclusions regarding the model's acceptability, and resolves certain items which were unresolved in an earlier status report issued by the NRC staff. (GRA)

32388 (RISO-M-1794) SOME ASSUMPTIONS UNDERLYING RELIABILITY PREDICTION. Taylor, J. R. (Danish Atomic Energy Commission, Risoe. Research Establishment). Apr 1975. 10p. INIS.

The whole process of reliability prediction for power plants rests on certain assumptions about the way components and the plant behave. It is important to check if these assumptions hold in practice. In some cases they do not, and here the normal procedures of failure mode analysis and fault tree analysis must be modified and supplemented. Some of the more important assumptions are discussed. (auth)

32389 (STH-3/75) INVESTIGATION OF THE RADIATION EXPOSURE DUE TO THE OPERATIONAL GASEOUS EFFLUENTS IN THE ENVIRONMENT OF THE NUCLEAR POWER PLANT NEAR GUNDREMMINGEN. Eickelpasch, N.; Huber, O. (Bundesgesundheitsamt, Neuherberg/Muenchen (F.R. Germany). Inst. fuer Strahlenhygiene). Jul 1975. 24p. (In German). INIS.

The nuclear power plant RWE-Bayernwerk GmbH situated near Gundremmingen was set to work in 1966. During the eight years of operation, the radioactive gaseous effluents were considerably under the licensed limits. Radiation exposure in the environment of the nuclear power plant at Gundremmingen is essentially determined by the released noble gases and by iodine-131. The maximum external radiation exposure to the gaseous effluents was about 0.5-2 mrem/a, except in the year 1973, in which a maximum value of 4 mrem/a was reached due to higher releases of noble gases. Considering the pasture-cow-milk-pathway, a thyroid exposure of about 5-20 mrem/a was calculated. A comparison between calculated and measured iodine contamination in milk reveals that the meteorological and ecological parameters used for the calcula-

tion of the above exposure include considerable safety factors leading to a conservative result. The operational experience regarding the gaseous release of radioactive substances from the plant as well as procedures to calculate the radiation exposure and the resulting data are reported on.

32390 (WCAP-8642(Vol.1)) BLOWDOWN EXPERIMENTS WITH UPPER HEAD INJECTION IN G-2 17 x 17 ROD ARRAY FACILITY. Volume 1. Test Facility, Procedures, and Data. Andreychek, T. S.; Fayfich, R. R.; Lee, A. Y.; McKown, D. L.; Mendler, O. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jan 1976. 568p. Westinghouse Electric Corp., Pittsburgh, PA.

The report presented describes the G-2 test facility, test procedures, methods of data reduction, and the data obtained in a series of 24 blowdown experiments with Upper Head Injection (UHI) performed by the Westinghouse Electric Corporation to provide experimental heat transfer data applicable to pressurized water reactors having 17 x 17 fuel assemblies. The test bundle had a heated length of 164 inches and contained 336 electric heater rods (including 82 instrumented rods) in a 17 x 17 rod array. The parameter effects investigated were UHI flow rate, UHI flow subcooling, rod bundle power, test vessel pressure, initial peak clad temperature, upper plenum inlet flow rate, upper plenum flow quality, and UHI flow distribution. The data reported herein include rod clad temperatures, test section fluid temperatures, and test section pressure drops. The analysis of the data is presented in Volume 2.

32391 (XN-75-6(A)) FLOW BLOCKAGE MODEL FOR LOCA ANALYSES. (Exxon Nuclear Co., Richland, Wash. (USA)). 29 Jan 1976. vp. Exxon Nuclear Co., Inc., Richland, WA.

Statistical models are developed for predicting the magnitude of flow blockages in reactor fuel assemblies. Parameters in these models are evaluated with experimental rod bulging data from single and multi-rod tests that simulated LOCA conditions. The statistical models utilize bulge strain data and may be used to evaluate the following effects on maximum planar flow area blockage fraction: presence of guide tubes, deformation of rods which have not bulged, movement of rod centers, different bulging probabilities between rods, and axial bulging distribution. The experimental data has shown the clad stress at bulging to be the primary variable for flow blockage.

32392 (XN-75-19(A)) CARRYOUT RATE FRACTION CORRELATION FOR PRESSURIZED WATER REACTORS. Lang, F. D. (Exxon Nuclear Co., Richland, Wash. (USA)). 24 Mar 1975. 22p. Exxon Nuclear Co., Inc., Richland, WA.

Safety analysis of pressurized water reactor segregates accidents involving loss of coolant generally into three time frames: blowdown, heatup and reflood. For evaluation of the effects of the reflood transient, knowledge of the reactor's outlet flow rate and the level of the quench front along the rod length is vitally important. To obtain a measure of this flow rate a correlation of the carryout rate fraction (CRF) has been developed from experimental data. The correlation was specifically developed for low flooding rates currently being encountered in loss of coolant accident analyses. Until this time no correlation has been available which reasonably predicts carryout rate fraction for flooding rates less than 2.0 in/sec.

32393 CEAG AIR FILTERS FOR NUCLEAR POWER PLANTS. Staub J. (Dortmund); 17: No. 70, 2-4(Sep 1975). (In German)

With figs.

The paper demonstrates that nuclear power stations equipped with high-quality air filters are clean in operation as compared to conventional power stations, and that the radioactive emissions are below the natural atmospheric activity. (DE)

32394 SAFETY-RELATED OCCURRENCES IN AMERICAN LIGHT-WATER REACTORS FROM 1967 TO 1974 AND COMPARISON OF FAILURE ERROR RATES OF SPECIAL REACTOR COMPONENTS. Boeck, H. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Atomkernenergie; 26: No. 4, 242-248 (1975). (In German)

15 tabs.; 21 refs.

A survey is given on safety-related occurrences and their distribution on systems and components of US light water cooled reactors in the period from 1967 and 1974. The basis of this survey is information from the Oak Ridge Nuclear Safety Information Center. The failure rates of special reactor components were calculated and compared to published failure rates. (DE)

32395 DATA ACQUISITION SYSTEM FOR THE LARGE-SCALE NUCLEAR REACTOR CONTAINMENT PLANT. VDI (Ver. Dtsch. Ing.). Z.; 117: No. 20, 960-961(Oct 1975). (In German)

1 fig.; 1 ref.

The large-scale nuclear reactor containment plant set up in the Battelle Institute is for the simulation of a pipeline rupture. Thermodynamic and flow-mechanical processes as well as stresses of certain concrete structures must be recorded as an entity in these experimental investigations. This requires the use of a measured value acquisition system adapted to the test course with a process computer which is described. (DE)

32396 FIRE PROTECTION CONCEPT FOR POWER STATIONS. Zitzmann, H. BBC-Nachr.; 57: No. 8/9, 487-492 (1975). (In German)

2 figs.

A systematic approach to the design of a fire-protected power station is described. The special conditions of an individual power station are treated as marginal conditions. How the concept is realized in the completed power station is presented taking account of the information provided by fire statistics. (DE)

32397 THE POSSIBILITIES OF OUTPUT CONTROL OF A NUCLEAR POWER HEAT SOURCE AND THE EFFECT THEREOF ON A DISTRICT HEATING SYSTEM. Bortlik, J. Bull. EGU; No. 77, 19-22(1971). (In Czech)

The requirements for centralized heat supply systems are discussed with a view to dynamic properties of nuclear heat and power sources. The analysis is presented showing that the control range and the rate of the change in the output of a WWER nuclear heat and power plant fully satisfies the demands of heat and power systems. (INIS)

32398 THE ANALYSIS OF THE TIME-DEPENDENT OPERATIONAL STRESS OF REACTOR COMPONENTS. Pt. 1. Klaetschke, H.; Zaschel, J. M. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e. V., Darmstadt (F. R. Germany). Lab. fuer Betriebsfestigkeit). Maschinenschaden; 48: No. 4, 117-118(1975). (In German).

Two methods are described which enable the analysis of load and stress-time functions: (1) time analysis, and (2) statistic counting methods (occurrence of certain events which are counted according to given characteristics). The application of both methods is demonstrated by the example of measured plots of pressure fluctuations which were set up during blowdown tests in Marviken. (DE)

32399 FILM BOILING HEAT TRANSFER FROM SPHERICAL PARTICLES TO SUBCOOLED LIQUIDS. Farahat, M. M.; El Halfawy, F. Z. (Alexandria Univ. (Egypt). Dept. of Nuclear Engineering). Atomkernenergie; 26: No. 4, 235-241(1975).

Film boiling heat transfer from spherical particles to liquids was analyzed. The effect of thermal radiation and liquid subcooling were considered. Coupling between heat and mass transfer at the liquid-vapor interface was included. Several parameters of interest in the study of fuel-coolant interaction, such as vapor generation rate, film thickness and heat flux, were calculated. The dependence of those parameters on liquid subcooling, wall superheat and particle size was investigated for both liquid sodium and water. An equation was derived relating the total heat transfer to the heat transferred due to radiation and liquid subcooling. The results of this study show that liquid subcooling is an important parameter in reducing the rate of vapor generation and enhancing the dissipation of heat into the subcooled liquid during fuel-coolant interaction. It is also demonstrated that the rate of heat transfer increases as the particle diameter decreases. (DE)

32400 SAFETY-TECHNICAL ASSESSMENT OF FAULTY WELDED JOINTS OF REACTOR COMPONENTS. Bartholome, G.; Vasoukis, G. (Kraftwerk Union A. G., Erlangen (F. R. Germany)). VGB Kraftwerkstech.; 55: No. 10, 691-696(Oct 1975). (In German).

From VGB conference on materials and welding techniques in power plants, VGB materials conference; Duesseldorf, F. R. Germany (26 Nov 1974). 11 figs.; 1 tab.; 11 refs.

Data on permissible faults in service inspections for reactor components are connected with experience values and with the state of development and use of nondestructive testing methods. Should the detected fault exceed these values, these faults must be assessed. The safety distance for operations, accidents, and emergencies can be fracture mechanically measured. This is shown using the example of the welded joint of a reactor pressure vessel. (DE)

32401 LIMNOLOGICAL AND BIOLOGICAL STUDIES OF THE EFFECTS OF TWO MODES OF OPEN-CYCLE NUCLEAR POWER STATION DISCHARGE ON THE MISSISSIPPI RIVER (1969-1973). Eiler, H. O.; Delfino, J. J. (Ind BIO-TEST Lab Inc, Northbrook, Ill). Water Res.; 8: No. 11, 995-1005(Nov 1974).

The impacts of the two modes of open-cycle condenser cooling at Quad-Cities Station on the aquatic environs of the area are compared. The station consists of two 809 MW(e) General Elec-

tric boiling water reactors and withdraws 2270 cubic feet per second of Mississippi River water for condenser cooling. The temperature of the condenser water discharge under normal full load conditions is approximately 12.8°C above ambient river water temperature.

32402 MULTIDIRECTIONAL APPROACH TO SEISMIC ANALYSIS. Gelman, A. P. (Rockwell Int Corp, Canoga Park, Calif). J. Pressure Vessel Technol.; 96: No. 4, 246-250(Nov 1974).

32403 ON THE ESTIMATED MODES OF FAILURE OF NUCLEAR POWER PLANTS BY POTENTIAL EARTHQUAKES. Shibata, H.; Akino, K.; Kato, H. (Univ of Tokyo, Jpn). Nucl. Eng. Des.; 28: No. 2, 257-277(Sep 1974).

The mechanisms of failure are categorized as follows: the static effect of force caused by acceleration, the resonance effect to acceleration waves, the resonance effect to displacement waves, the direct effect of relative displacement caused by a fault or motions of supporting structures, and the effect of liquefaction of supporting ground. The modes of failure are determined for the following items: the reactor building, steel containment vessel, auxiliary building, reactor vessel, core internals, primary and secondary coolant system, emergency power supply system, emergency gas treatment system and stack, fuel cooling pond and fuel rack, refuel machine crane, auxiliary system and component, turbine and its pedestal, and main power system and control instrumentation.

32404 DESIGNING EARTHQUAKE RESISTANT NUCLEAR POWER PLANTS. Rep, C. VGB Kraftwerkstech.; 54: No. 10, 696-698(Oct 1974). (In German).

Proposed building code for seismic safety of the nuclear power plants, by the West German Nuclear Power Committee (KTA) is presented. 6 refs.

32405 REVIEW OF SOIL-STRUCTURE INTERACTION EFFECTS IN THE SEISMIC ANALYSIS OF NUCLEAR POWER PLANTS. Scavuzzo, R. J.; Raftopoulos, D. D. (Univ of Akron, Ohio). Nucl. Eng. Des.; 28: No. 3, 400-413(Sep 1974).

A survey of investigations of soil-structure interaction in the seismic analysis of nuclear power plants is presented. After a discussion of various methods that have been applied to calculate interaction effects, results of various investigations are discussed. Differences in system response associated with various analytical models are pointed out. Conclusions and recommendations for additional studies are made. 54 refs.

32406 TRANSLATIONS: SAFETY CODES AND GUIDES. Edition, 2/75. Compilation of Information on Siting Characteristics Required for Examination Purposes in the Licensing Procedures of Nuclear Power Plants. Cologne; Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V. (1975). 11p.

32407 GAS RELEASE FROM A DEFECTIVE FUEL PIN AFTER REACTOR SHUT-DOWN. Pshenichnikov, B. V. At. Energ. (USSR); 39: No. 6, 400-402(Dec 1975). (In Russian).

A mathematical model of gas release from a defective ceramic fuel pin in the core of a light-water reactor after shut-down is considered. It is shown that the pressure transient inside and outside the fuel pin lasts only several seconds. A large part of the gaseous products emerges from the cladding of the defective fuel pin and enters the coolant as the pressure inside the reactor decreases from operating to atmospheric levels. (7 references) (auth)

32408 RISKS FROM NUCLEAR POWER PLANTS. Dtsch. Aerztebl. 70: No. 1, 21-24(Jan 1973). (In German).

Comments on the contributions of Graul, E. H., published in Dtsch. Aerztebl., v. 41 p. 2751 (1971); v 42 p. 2228 (1971). Separate print.

Enemies and advocates of nuclear power discuss the potential threat to the population posed by the operation of nuclear power stations. (DE)

32409 DATA ACQUISITION AND DATA PROCESSING IN THE EXPERIMENTAL CONTAINMENT FACILITY. IRS Kurz-Inf., Reihe D. 35: No. 19, 1-9(1975). (In German).

3 figs.; 1 ref.

In the experimental investigations in the field of reactor safety, many individual phenomena must be integrally acquired under difficult conditions. As an example, the measured value acquisition and processing in the experimental investigations on the large experimental facility "nuclear reactor containment" assigned by the Federal Ministry of Research and Technology are described. (DE)

32410 SODIUM FIRES IN NUCLEAR FACILITIES. Menzenhauer, P. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Brandschutz; 28: No. 2, 36-41 (1974). (In German)

The work deals with the behavior of liquid sodium when it comes into contact with air, especially in the course of fires in technical plants. The most important fire procedures are constructed as realistically as possible, that is to say that the fires were not only carried out on a laboratory scale but with quantities of up to 200 kg sodium at temperatures of up to 800°C. The following was investigated: (1) the course of the fire in rooms, (2) restriction of the fire, (3) removal of the burnt remains, and (4) protection measures. The fire was varied in its most important physical appearance such as surface fire, spurt fire and fire on isolated pipe lines. The fires were checked by precautionary, constructive measures and by active measures, such as covering with extinguishing powder. All important test phases were captured in film and slide series. Visible material is thus available for the operation team of sodium plants and fire brigades who might possibly be called upon.

32411 CONSTITUTION AND REACTION BEHAVIOR OF LWR COMPONENTS DURING A MELTDOWN ACCIDENT. Hofmann, P.; Holleck, H.; Politis, C.; Skokan, A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). KFK Nachr.; 7: No. 3, 50-57(1975). (In German)

Investigations are carried out within the framework of the nuclear safety project in the complicated multimaterial system UO_2, Zry, steel, steam, air. The experiments are divided into three parallel parts which are to supplement and support each other: 1) constitutional investigations in defined systems; 2) reaction investigations in core components; 3) phase analytical investigations on melting rods. (DE)

32412 LIMITS ON SODIUM VOIDING REACTIVITY ADDITION RATE FOR VERY LARGE LIQUID-METAL FAST BREEDER REACTORS. Hummel, H. H.; Kalimullah; Pizzica, P. (Argonne National Lab., IL). Nucl. Sci. Eng.; 59: No. 4, 440-441(Apr 1976).

Recalculation of sodium voiding ramp rates in a loss-of-flow accident for a model of a 4000-MW(e) oxide-fueled liquid-metal fast breeder reactor gave results much lower than those found previously by Bleiweis et al. Only a part of this difference could be ascribed to differences in the primary coolant loop model.

32413 SUBCOOLED DECOMPRESSION ANALYSIS IN PWR LOCA. Namatame, K.; Kobayashi, K. (Tokai Research Establishment, Japan). J. Heat Transfer; 98: No. 1, 12-18(Feb 1976).

The thermo-hydraulic behavior of the coolant in the primary system of a nuclear reactor is important in the core heat transfer analysis during a hypothetical loss-of-coolant accident (LOCA). The heat transfer correlations are strongly dependent on local thermo-hydraulic conditions of the coolant. The present work allows to calculate such thermo-hydraulic behavior of the coolant during subcooled decompression in PWR LOCA by solving the mass, momentum, and energy conservation equations by the method of characteristics. Detailed studies were made on the transient coolant outflow at the pipe rupture and the effect of frictional loss and heat addition to the coolant on the decompression. Based on the studies, a digital computer code, DEPCO-MULTI, has been prepared and numerical results are compared with the ROSA (JAERI) and the LOFT (NRTS) semiscale test data with various coolant pressures, temperatures, pipe break sizes, and complexity of flow geometry. Good agreement is generally obtained.

32414 MOLECULAR GAS RADIATION IN A LAMINAR OR TURBULENT PIPE FLOW. Wassel, A. T.; Edwards, D. K. (Univ. of California, Los Angeles). J. Heat Transfer; 98: No. 1, 101-107(Feb 1976).

The temperature profile and the radiative and convective wall-heat fluxes for a hydro-dynamically established flow of a nongray gas in a cylinder are calculated numerically for laminar or turbulent flow. Turbulent eddy viscosity is represented by a two-region model having a near-wall-region and a far-from-wall region. Gas properties are represented by the exponential-winged band model. Qualitatively the results for a gas with a single major band agree with a previous solution for a cylinder with internal heat generation.

32415 LAMINAR FILM CONDENSATION ON A VERTICAL MELTING SURFACE. Epstein, M.; Cho, D. H. (Argonne National Lab., IL). J. Heat Transfer; 98: No. 1, 108-113(Feb 1976).

Laminar film condensation of a saturated vapor on a vertical melting surface is treated theoretically, with emphasis on departures from a previous treatment produced by: (a) arbitrary liquid Prandtl numbers and (b) condensation-melting systems involving two materials of immiscible liquids. An integral method is utilized which takes full account of the effects of both liquid film inertia and shear force at the condensing vapor-liquid film

interface. For a one-component system accurate numerical results for the melting rates are displaced graphically and define the range of validity of a simple treatment of this problem based on Nusselt's method. For a two-component system, illustrative calculations are made for the condensation of a refrigerant vapor on melting ice.

32416 NUCLEAR ENERGY'S SOLUTION TO AIR-POLLUTION PROBLEMS. Basson, J. K. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Isotopes and Radiation Div.). Clean Air J.; 2: No. 2, 18-30(Feb 1975).

From the impact of the energy crisis on air pollution; Johannesburg, South Africa (1 Nov 1974).

Nuclear reactors are established for the generation of base-load electricity. The resultant airborne radioactive releases, during normal operation, are reviewed and shown to be substantially less hazardous to human health than the air pollution from conventional coal-fired plants. The experience gained with the research reactor SAFARI-1 at Pelindaba has been put to use for a preoperational investigation at Duynefontein, the site for South Africa's first nuclear power station, Koeberg A, 28 km north of Cape Town. The capacity of the environment to accept radioactive effluent has been studied using the critical pathway concept. It is concluded that such a preoperational survey may serve as example to conventional industry. Furthermore, nuclear techniques for tracing airborne releases have great potential for conventional air pollution studies.

32417 FEATURES OF HEAT TRANSFER DURING EMERGENCY COOLING OF THE FUEL ELEMENTS. Kabanov, L. P.; Khasanov, R. Kh. (Moskovskij Ehnergeticheskij Inst. (USSR)). Kernenergie; 18: No. 5, 138-141(1975). (In German).

The problem of cooling a reactor with high power density following a loss of coolant accident has been studied. The thermodynamic processes involved have not yet been sufficiently cleared up. A phenomenological review is given, published data are evaluated, and the results of calculations by the authors are compared with those published in literature.

32418 NUCLEAR DESIGN: SAFETY IS ESSENTIAL. Pon, G. A. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. Power Projects). Des. Eng. (Toronto); 21: No. 6, 20-21(Jun 1975).

The protection of both operating staff and the public is the primary consideration in nuclear reactor safety philosophy. There are three levels to this approach. First, there is an intrinsic emphasis on safety throughout design by the use of highest quality materials and the use of redundancy and fail-safe systems. Secondly there is emphasis on the provision of reliable protective systems. At a third level are additional safety systems to act if the protective systems should fail simultaneously with the accident they are intended to control. The low levels of radioactive gas release from Pickering Generating Station in 1974 are given in a table.

32419 DESIGN AND SAFETY ASPECTS OF THE NUCLEAR REACTORS FOR KOEBERG POWER STATION. Regan, J.; Walmsley, J. (Electricity Supply Commission, Johannesburg (South Africa)). Trans. S. Afr. Inst. Electr. Eng.; 2-12(Jan 1975).

After a brief introduction to nuclear power generation, the basic concepts of the two types of light water reactors under consideration for Koeberg Power Station and some of the important design aspects of the boiling water reactor (BWR) are discussed. The safety criteria employed in nuclear stations in general and in the BWR in particular are described, with emphasis on the containment of the fission products under normal operation, the limits adopted in connection with radioactive effluents and waste and the safeguards provided against melt out and release of radioactive material under disaster conditions.

32420 EXPERIMENTAL STUDY OF WATER OUTFLOW FROM A VESSEL DURING ABRUPT PRESSURE DROP. Dement'ev, B. A.; Ionov, B. A.; Kuznetsov, V. D.; Skachek, M. A. (Moskovskij Ehnergeticheskij Inst. (USSR)). Kernenergie; 18: No. 5, 142-144(1975). (In German).

The results of an experimental study concerned with the mechanism of water outflow from a vessel during abrupt pressure drop are presented. In particular, the distribution of steam content over the height of the vessel has been investigated using a gamma-ray transmission technique. The experiments were carried out on a 160 liter vessel with or without inserts for various rates of pressure drop.

32421 CALCULATION OF HYDRODYNAMICS OF THE PRIMARY COOLANT CIRCUIT IN NUCLEAR POWER PLANTS EQUIPPED WITH WATER-COOLED, WATER-MODERATED POWER REACTORS FOR THE CASE OF LOSS OF COOLANT ACCIDENT. Dement'ev, B. A.; Katkovskij, E. A. (Moskovskij Ehnergeticheskij Inst. (USSR)). Kernenergie; 18: No. 5, 145-147 (1975). (In German).

A method of calculating pressure and flow rate distribution of a single-phase coolant in one-dimensional approximation is described that is based on the general solution of Joukowski's hydrodynamic equations for a liquid flowing through a homogenous channel. Mutual influences of the homogenous sections are taken into consideration using appropriate boundary conditions. A system of algorithms has been established for the BESM-6 computer. First, the method was tried for models having simple geometry whereby the programs were optimized, then it was applied to hydrodynamics of the primary coolant circuit of a 440 Mw pressurized water nuclear power plant for the case of a large leak in a pipe 500 mm in diameter.

32422 DECISION PROBLEMS IN POWER PLANT SYSTEMS OF LARGE POWER. Adam, E.; Altmann, W.; Munser, H.; Schilg, G. (Technische Universitaet, Dresden (German Democratic Republic). Sektion Energieumwandlung). Energietechnik; 24: No. 7, 282-289(1974). (In German).

Nuclear safety is a new decision criterion which affects the installations in nuclear power plants. The one-shell containment with ice condenser and the double containment with ice condenser are compared in their economics and safety criteria.

32423 ON PRESSURE CHANGE IN A HERMETICALLY TIGHT CONTAINMENT SHELL DURING INRUSH OF COOLANT. Rassokhin, N. G.; Kuzevanov, V. S. (Moskovskij Ehnergeticheskij Inst. (USSR)). Kernenergie; 18: No. 5, 147-150(1975). (In German).

Changes in pressure in the containment shells of nuclear power plants due to an accident with loss of coolant are shown to be obtainable in a good approximation without employing voluminous computer programs, if the coolant inflow from the circuit being out-of-order is known.

32424 RECENT OCCURRENCES AT NUCLEAR REACTORS AND THEIR CAUSES. Scott, R. L.; Gallaher, R. E. Nucl. Saf.; 17: No. 2, 242-247(1976).

The safety-related occurrences on which reports were received at the Nulcear Safety Information Center during November and December 1975 are listed. Docket numbers and the dates of the reports are included. The occurrences listed are only those at operating research reactors and at power reactors that are in commercial operation.

32425 SELECTED SAFETY-RELATED OCCURRENCES REPORTED IN NOVEMBER AND DECEMBER 1975. Casto, W. R. Nucl. Saf.; 17: No. 2, 248-253(1976).

Brief descriptions are presented of the freezing of ice-condenser doors at the Donald C. Cook nuclear plant and of a hydrogen explosion at the Cooper nuclear plant.

32426 STEAM-WATER MIXING STUDIES RELATED TO EMERGENCY CORE-COOLING SYSTEM PERFORMANCE. Cudnik, R. A.; Carbiener, W. A. (Battelle Columbus Labs., OH). Nucl. Saf.; 17: No. 2, 185-193(1976).

A review is presented of recent experimental work related to the interactions between the primary-system fluid and emergency core-cooling (ECC) water in light-water-reactor systems during recovery from a postulated loss-of-coolant accident. The testing programs are exploratory separate-effects tests in reduced-size simulators of reactor systems. The tests address the cold-leg manometer loop, the cold-leg pipe–ECCS injection section, and the downcomer annulus–lower plenum regions of reactor systems. Data to date indicate the absence of cold-leg pipe plugging, the presence of oscillatory flow behavior initiated by full pipe flow, and the predominant role of condensation in both the injection section and annulus regions.

32427 RELAP4 COMPUTER CODE. I. Application to Nuclear Power-Plant Analysis. Solbrig, C. W.; Barnum, D. J. (Aerojet Nuclear Co., Idaho Falls, ID). Nucl. Saf.; 17: No. 2, 194-204(1976).

The RELAP4 computer code is a very useful tool for nuclear safety analysis. It is used principally in the analysis of the hypothetical loss-of-coolant accident but is also used in several other applications. A description is given of the basic fluid model; the improvements over its predecessor, RELAP3; and a further modification, RELAP-EM, specifically designed to produce conservative results. RELAP4 is compared to other similar codes, and the generic limitations of these codes are noted. It is concluded that RELAP4 is an example of the better current nuclear safety codes.

32428 MESO-METEOROLOGICAL EFFECT OF THERMAL RELEASES FROM NUCLEAR POWER PLANTS IN THE GW RANGE. Bahloul, C.; Le Berre, P. pp 3.11-1–3.11-4 of Proceedings of the 13th Hydraulics Meeting. Effects of Human

Activities on the Hydrometeorological Cycle. Paris, September 16-18, 1974. Paris, France; Societe Hydrotechnique de France (1975). (In French).

From 13th hydraulics meeting. Effects of human activities on the hydrometeorological cycle; Paris, France (16 Sep 1974).

A comparison is made between the energy released by nuclear power plants into the environment and the energy brought into action by meso-meteorological phenomena. Observations on the occasion of important heat release (forest fires) are made and compared with the thermal effluents generated by nuclear power plants. (FR)

32429 RADIATION PROTECTION AND THE DEVELOPMENT OF NUCLEAR POWER PLANTS. Bovard, P.; Fitoussi, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Lion (Paris); No. 225, 21-24 (Jan 1975). (In French).

Radiological hazards are defined. Following a short explanation of the International Commission on Radiation Protection's permissible values of exposure, some indicators are given about the component of natural radioactivity. (FR)

32430 RADIATION PROTECTION AND THE DEVELOPMENT OF NUCLEAR POWER. Bovard, P.; Fitoussi, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Lion (Paris); No. 234, 46-53(Oct 1975). (In French).

Lights are given on the nature and origins of the radioactivity that could be added to the environment on account of human activities in the electronuclear field and information is given on the investigations undertaken in the field of radiation protection to follow the fate of such radioactivity and assess its possible contribution to populations' exposures. (FR)

32431 NUCLEAR POWER PLANT SAFETY. pp 189-228 of Operation of Novo Voronezh Nuclear Power Plant Reactors. Prague; SNTL-Nakladatelstvi Technicke Literatury (1974). (In Czech).

Translated from "Ehkspluatatsiya reaktornykh ustanovok Novo-voronezhskoj AES", Moscow, Atomizdat, 1972. (Ceskoslovenska Komise pro Atomovou Energii, Prague).

The criteria are discussed of safe and reliable operation of the nuclear power plant and the permissible output is determined of the fuel assemblies and of the reactor as a whole for the actual output distribution. The instrumentation and the methods for the thermal and neutron control are described and the cartograms are listed of the location of regulating assemblies and channels for temperature and neutron sensors in reactors WWER 210 and WWER 365. The technical specifications are presented of the control system and of the emergency protection of the WWER 365 reactor. Also the system of a reliable electric power supply is described as are the systems of the dosimetric inspection and of the biological protection in a WWER-type nuclear power plant. (INIS)

32432 SAFETY PROBLEMS OF NUCLEAR POWER PLANTS SITED CLOSE TO URBAN AREAS. Kadlec, J. Jad. Energ.; 19: No. 11, 392-395(Nov 1973). (In Czech).

A survey is presented of the philosophies current in western Europe and in CMEA countries concerning the siting of nuclear power plants in densely populated areas. The VVER 1000 project envisages a containment most probably applicable also for the VVER 440 reactor. Measures must be taken preventing the occurrence of accidents, and also measures limiting and/or removing the consequences of accidents. The solution of safety problems in Czechoslovakia is based on research and development programmes and mainly on cooperation with the USSR. (Nuclear Sci. Abstr. Czech.)

32433 SIMULATED AND SIMULTANEOUS LOSS-OF-COOLANT ACCIDENT TESTING OF PROTECTIVE COATINGS FOR THE NUCLEAR INDUSTRY. Oberbeck, W. F. Jr. (Univ. of Missouri, Rolla); Mayhan, K. G.; Edwards, D. R.; Lopata, J. R.; Montle, J. F.; Leritz, D. R. Nucl. Technol.; 28: No. 2, 183-193(Feb 1976).

An apparatus was designed and constructed to test the performance of coatings under conditions of high-pressure steam and radiation that might exist under a loss-of-coolant accident (LOCA). Results from the "simultaneous" exposure of coatings to high-pressure steam and radiation are compared to results obtained from the conventional "simulated" test procedures. Coating systems were selected that had a history of performing well under simulated LOCA conditions and included zinc-based, epoxy, and phenolic primers with phenolic and modified phenolic topcoats. Coatings were exposed to ^{60}Co radiation doses in the range of 10^8 to 10^9 rad. The study showed that the conventional simulated LOCA conditions were more severe on the coatings than those tested under the simultaneous exposure to high-pressure steam and ^{60}Co radiation. It was concluded that coatings that satisfactorily passed the simulated LOCA tests will also pass the simultaneous LOCA tests.

32434 PROBABILITY OF A TURBINE MISSILE HITTING A PARTICULAR REGION OF A NUCLEAR POWER PLANT. Bhattacharyya, A. K.; Chaudhuri, S. K. (United Engineers and Constructors, Inc., Philadelphia). Nucl. Technol.; 28: No. 2, 194-198 (Feb 1976).

A method to determine the probability of a turbine missile striking a specified region of a nuclear power plant uses the concept of geometrical probability of a missile trajectory to intersect a target area. The geometrical probability is derived as a function of the missile exit parameters and the plant geometry. The method is general and can be applied to two- or three-dimensional problems. A computer code, TURBMSL, has been developed by the United Engineers and Constructors to obtain the numerical results. The effectiveness and the reliability of the present method have been demonstrated. (auth)

32435 HAZARDS TO NUCLEAR PLANTS FROM OFF-SITE RELEASE OF TOXIC VAPORS. Hornyik, K. (Oregon State Univ., Corvallis). Nucl. Technol.; 28: No. 2, 199-207(Feb 1976).

A method for the assessment of risk involved in shipping toxic compounds past nuclear power plants uses a postulated chain of events, starting with a traffic accident causing instantaneous release of the compound as vapor, and leading to incapacitation of control operators in the nuclear plant, described by deterministic and statistical models as appropriate to the respective event. Statistical treatment of relevant atmospheric conditions is a major improvement over more conservative assumptions commonly made in current analyses of this problem. Consequently, one obtains a substantial reduction in the estimated risk expressed in usual terms of the annual probability of an unacceptable event, in spite of the fact that no credit is taken for protective measures other than potential control room isolation. (auth)

32436 SAFETY OVERRIDES ALL NUCLEAR CONCERNS. Hughes, E. A. III. (General Electric Co., San Jose, CA). Electr. World; 185: No. 5, 28-30(1 Mar 1976).

A brief discussion of reactor safety includes comments on inherent safety of light water reactor core designs, applied design safety, engineered safety systems, multiple confinement barriers, and multiple regulatory reviews of design, construction, and operation of nuclear power plants.

32437 EFFECTS DUE TO FISSION GAS DURING UNPROTECTED OVERPOWER TRANSIENTS IN A LIQUID-METAL FAST BREEDER REACTOR. Bogensberger, H. G. (Kernforschungszentrum, Karlsruhe, Ger.); Ronchi, C. Nucl. Technol.; 29: No. 1, 73-85(Apr 1976).

A behavior model for fission gas in irradiated liquid-metal fast breeder reactor fuels is applied in a computer code. The subroutine LANGZEIT calculates the kinetics processes during steady-state operation. The results are used as initial conditions for the subroutine KURZZEIT, which permits the description of the bubble growth during rapid overpower transients. This model has been applied to the SNR-300-Mark I core. The calculations indicate a prompt precipitation of fission gas during the reactivity excursions, which results in a dampening effect on the reactivity ramps.

32438 REVIEW OF THE AMERICAN PHYSICAL SOCIETY LIGHT WATER REACTOR SAFETY STUDY. Budnitz, R. J. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 25-27(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The issue of light-water reactor (LWR) safety has been the subject of a part-time, year-long study sponsored by the American Physical Society and supported by the National Science Foundation and the former Atomic Energy Commission. The goal of the study was the assessment of some of the technical aspects of the safety of large light water nuclear power reactors typical of present commercial practice in the United States. The Report examines issues related to the safe operation of LWRs; the research and development program responsible for establishing and enhancing safety; and the consequences of accidents for public health and welfare. A number of recommendations are contained within the Report, mainly addressed to ways in which the safety of the present LWRs can be improved and better understood. A brief summary of the Report is presented.

32439 NEW BORON HEAT TRACE CONTROL SYSTEM MEETING IEEE 338. Paul, A. N. (Sigma Instruments, Inc., Orange, CT). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 391-396 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A boron trace control/alarm system has been designed and installed for pressurized water reactors. It is the first centralized control that meets IEEE 338 "Criteria for Periodic Testing of Nuclear Power Generating Station Systems." A case study is presented of a control system specifically designed for the temperature control and alarming of a boron dumping system in a pressurized water reactor plant; a subject that, until recently, was frequently an afterthought in nuclear plant construction planning.

32440 IMPROVED TESTABILITY PROVISIONS FOR BOILING WATER REACTORS. McGrath, J. N. (Philadelphia Electric Co.). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 782-784(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

Safety Systems (Emergency Core Cooling and Reactor trip) circuits at Peach Bottom were provided with complete, overlapping zone, on-line testability. This was accomplished by adding to and greatly expanding the coverage of the manufacturer installed test plugs. The general philosophy is that with proper insertion of test plugs, full logic initiation can be tested including valve operation and pump starts. No jumpers or lifted leads are required and injection into the core is defeated during tests. These provisions simplified the testing program for Technical Specification requirements and eased licensing considerations. Although applied to a BWR, the principles outlined are applicable to any system or plant using digital inputs.

Reactor Theory and Calculation

Refer also to abstracts 31643 and 32332.

32441 (CONF-760408-1) REACTOR NOISE ANALYSIS BY STATISTICAL PATTERN RECOGNITION METHODS. Howington, L. C.; Gonzalez, R. C. (Oak Ridge National Lab., Tenn. (USA)). 1976. 42p. Dep. NTIS $4.00.

From IEEE southeastern conference; Knoxville, Tennessee, United States of America (USA) (Apr 1976).

A multivariate statistical pattern recognition system for reactor noise analysis is presented. The basis of the system is a transformation for decoupling correlated variables and algorithms for inferring probability density functions. The system is adaptable to a variety of statistical properties of the data, and it has learning, tracking, updating, and data compacting capabilities. System design emphasizes control of the false-alarm rate. Its abilities to learn normal patterns, to recognize deviations from these patterns, and to reduce the dimensionality of data with minimum error were evaluated by experiments at the Oak Ridge National Laboratory (ORNL) High-Flux Isotope Reactor. Power perturbations of less than 0.1 percent of the mean value in selected frequency ranges were detected by the pattern recognition system.

32442 (CTOM-17875) THE STRUCTURE OF TURBULENT FLOW IN TRIANGULAR ARRAY ROD BUNDLES. Trupp, A. C. (Manitoba Univ., Winnipeg (Canada). Dept. of Mechanical Engineering). 1973. 273p. INIS.

Microfiche only.

An experimental study of fully developed uniform-density turbulent flow through triangular array rod bundles is described. The pitch-to-rod diameter (P/D) ratios were 1.20, 1.35 and 1.50, and the Reynolds number range was 12,000 to 84,000. Based on the equivalent hydraulic diameter concept, friction factors were found to be functions of both Reynolds number and P/D ratio. Local wall shear stress variations were much smaller than predictions ignoring secondary flow, and the maxima did not occur at the positions facing the sub-channel centerline. Spatial distributions of the mean axial velocity, when scaled on the bulk average axial velocity, were substantially independent of Reynolds number and P/D ratio, but the radial distributions were modified forms of the universal logarithmic laws. The turbulence data were found to scale only fairly well on the average friction velocity. The normalized radial distributions of the normal stresses and the primary shear stress ($\rho\overline{uv}$) were fairly similar to the distributions for fully developed pipe flow. The experimental data also include the shear stress $\rho\overline{uw}$, one-dimensional (axial) power spectra and the Taylor microscale. Using the experimental data, calculations were made for the mean turbulent kinetic energy, eddy diffusivities, and the approximate mean energy balance.

32443 (IAEA-R-1028-F) BURN-UP PHYSICS. Part of A Coordinated Programme on Fuel Burn-Up Calculations and Experiments for Thermal Reactors. Final Report for the Period 1 July 1971–30 June 1974. Pop-Jordanov, J. (International Atomic Energy Agency, Vienna (Austria)). Sep 1974. vp. INIS.

Research was devoted to one of the major problems in burnup studies, the reasonably fast and accurate calculation of the space-and-energy-dependent neutron flux and reaction rates for realistic power reactor fuel geometries and compositions, and its optimal integration in the global reactor calculations. A new matrix formalism to invert the coefficient matrix of band structure resulted in a reduction of computer time and memory demands. The research on epithermal region is finalized in the (SPLET) program which calculates the space-lethargy distribution of the spherical harmonics neutron flux moments, and the related integral quantities as reaction rates and resonance integrals. The partial verification of the above methods was developed by a Monte Carlo procedure. Expanding the neutron source and flux in finite series of arbitrary polynomials, the space-and-energy dependent integral transport equations is transformed into a general linear algebraic form, which is solved numerically. A multizone few-group program (SPECTAR), Space Points Energy Groups Transport in Annular Regions, for global reactor calculations was developed. The application of quasi-linear programming for solving the control rod distribution problem to achieve the maximum average fuel burn-up resulted in a flexible optimization procedure.

32444 (IFA-FR-124-1975) PRESEC–A CODE FOR CALCULATING EFFECTIVE MULTIGROUP CROSS SECTIONS FOR FAST REACTORS. Mocioiu, D.; Druta, E.; Cuculeanu, V.; Constantinescu, D. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 9p. (In Romanian). INIS.

The PERESEC code, written in FORTRAN-IV language, is devoted to the calculation of the microscopic and macroscopic multigroup nuclear data for homogenous compositions using a self schielding factor scheme. The program makes use of the A.B.B.N. multigroup set with 26 groups. A maximum number of 15 elements per composition is handled at once, the computer memory requested being 157k bits.

32445 (IFA-FR-125-1975) DEVELOPMENT OF THE COLLAPSING METHOD FOR MULTIZONE FAST REACTORS. Anton, V.; Pavelescu, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 16p. (In Romanian). INIS.

A method of calculating the zone spectra of a fast reactor, improved in the sense of considering the active zone coupling, is presented. At the same time, the collapsing method previously under consideration $K_{ef} = ct$ is now developed for the case $\Delta K_{ef} = ct$ which is important in the combustion problem. Together with this a method of calculating adjoint zone spectra on which the multigroup sections are averaged is approached. For this the adjoint equations of the diffusion approximation are written and solved accordingly. There are imposed the conditions of conservation of the reaction rate in the maxi and mini group system thus resulting in a new collapsing formula which contain both fluxes and adjoint fluxes.

32446 RSYST-I-III: EXPERIENCE AND FURTHER DEVELOPMENT. Ruehle, R. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Atomkernenergie; 26: No. 3, 185-189(1975).

5 figs.; 13 refs.

Since 1969, the modular system RSYST is used for reactor and shielding calculations. Data managed by a central program, data blocks containing structure descriptions, and hierarchical linking of data blocks enable flexible management of all data. Module sequences are formulated using a user command language. The language features logical branches, variables and arithmetic expressions. Sections of the user language may be stored in the data base and activated at any time. Presently, an interactive version of the system is developed. It supports basic operations and interactive input checking on a front end computer. (DE)

32447 FLUX SHAPE FACTORS FOR THE SIMPLIFIED CALCULATION OF CYLINDRICALIZED PIN CELLS WITH THREE ZONES. Blank, K. H. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Kerntechnik). Atomkernenergie; 26: No. 4, 261-264(1975). (In German)

5 figs.; 1 tab.; 7 refs.

For the cylindrical pin cell of a light water reactor a procedure is given to calculate the flux shape factor of the three zones: fuel, can and moderator. The flux shape factors are used to give weight to the cell-homogenized nuclide densities corresponding to their membership in a cell zone. They are a measure for the deviation of the flux in the respective zone from the cell-averaged flux, and can be determined in dependence of geometric parameters and effective cross sections. The calculation procedure of the flux shape factors can be incorporated in spectral programs like GGC-4 and thus make possible the automatic run of the spectral calculation, since the troublesome card input of the flux shape factors, usually predetermined by one-dimensional reference calculations, is avoided. The procedure is applicable to pin cells of a few per cent enrichment in which the spatial dependence of the spectrum is of only minor importance. (DE)

32448 USE OF THE P_3-L_1 MODEL IN STUDYING THERMAL NEUTRON DECAY IN A SPHERICAL MODERATOR. Nassar, S. F.; Hathout, A. M. (Cairo Univ. (Egypt). Dept. of Physics). Atomkernenergie; 26: No. 4, 255-256(1975).

2 figs.; 8 refs.

The decay of a neutron burst in a spherical moderator was been investigated using the P_3-L_1 model. Calculations were performed on water moderator. The neutron scattering kernel was represented by the heavy gas kernel. The curve obtained for the fundamental decay constant versus geometrical buckling showed a negative curvature at the origin, indicating that the model in question is capable of revealing the neutron cooling phenomenon that characterizes small systems. The calculated values of the lowest time eigenvalue are in better agreement with the experimental results than those of the P_1-L_1 model. Higher modes of the decay constants showed considerable variation in the P_3-L_1 model when compared to those in the P_1-L_1 approximation. (DE)

32449 FLOW RESISTANCE IN CROSS- AND LONGITUDINAL-FLOW IN ROD BUNDLES. Boettgenbach, H. (Bochum Univ. (F. R. Germany). Lehrstuhl fuer Reaktortechnik). Atomkernenergie; 26: No. 4, 229-234(1975). (In German)

10 figs.; 3 tabs.; 24 refs.

All measured pressure-drop factors which have been performed on cross- and longitudinal-flow in rod bundles are presented. The results are summarized in some diagrams and tables. Having defined a characteristic velocity and a characteristic diameter, it is possible to standardize all the different measured results. Formulas are given representing the friction factor in both cases with an acceptable accuracy. The maximum error is in case of cross flow ±16% for in-line and ±29% for staggered arrangement, while in case of longitudinal flow it is less than the accuracy of measurements. Only very few measurements have been made concerning rod bundles with different angles of flow. (DE)

32450 A COLLISION PROBABILITY METHOD FOR THERMAL FLUX DISTRIBUTION IN A REACTOR LATTICE. Elmeshad, Y.; Abushady, Y. (Alexandria Univ. (Egypt). Dept. of Nuclear Engineering). Atomkernenergie; 26: No. 4, 257-260(1975).

3 figs.; 1 tab.; 10 refs.

A general method for the calculation of the thermal neutron space distribution in a reactor cell of cylindrical geometry has been developed. The method is based upon the collision probability theory and can be used as an extension to methods capable of determining the regional thermal utilization factor in multiregion cells such as the Bonalumi method or the ABH method. The method avoids the inaccuracies associated with the process of dividing the cell into a large number of regions by introducing a temporary artificial region boundary at the cylindrical interface where it is necessary to calculate the flux value. Expressions are derived for the inward and outward neutron currents as well as the flux at the temporary artificial boundary by a collision probability method. The expressions are formulated in the form of recurrence formulas. Some approximations can be introduced to the proposed method in order to simplify the calculation and two kinds of such simplifications are discussed. Comparison with published and computed results of other methods as well as with experimental published results confirms the advantages of the method. (DE)

32451 CALCULATION OF HETEROGENEOUS NUCLEAR REACTORS BY THE METHOD OF INSERTED ELEMENTS. Slesarev, I. S.; Sirotkin, A. M. Sov. At. Energy (Engl. Transl.); 38: No. 6, 533-535(Jun 1975).

Translated from At. Energ.; 38: No. 6, 419-420(Jun 1975).

A general scheme for reactor physics calculations is presented. The method depends on representing the reactor by arbitrarily disposed zones of simple geometrical shape.

32452 HEAT TRANSFER CRISIS IN TUBULAR HEAT EMISSION ELEMENTS OF NUCLEAR POWER REACTORS. Subbotin, V. I.; Alekseev, G. V.; Peskov, O. L.; Sapankevich, A. P. Teploenergetika (Moscow); No. 9, 24-29(Sep 1974). (In Russian)

Principal regularities and methods of evaluation of the possibility of the appearance of critical situations in pipes with even and uneven lengthwise heat emission are considered. Ways and methods are indicated for influencing the two-phase flow in order to shift critical conditions of operation into the region of high steam contents. 13 refs.

32453 PRIMARY FISSION FRAGMENT YIELDS AND PROMPT-NEUTRON EMISSIONS FOR AFTER-HEAT ANALYSIS. Liaw, J. R. Corvallis, OR; Oregon State Univ. (1976). 192p. University Microfilms Order No. 76-3836.

Thesis (Ph. D.).

A systematic approach to correlating the relevant experimental and calculated ^{235}U thermal fission data with other nuclear data is presented so that with application constraints from exact physical laws, a consistent set of primary fission fragment yields can be generated. These are for use in improving the precision of after-heat calculations by constraining yield errors and thereby reducing the uncertainties caused by them. (Diss. Abstr. Int., B)

32454 APPLICATION OF INVARIANCE PRINCIPLES TO CRITICAL PROBLEMS IN REFLECTED REACTORS. Burkart, A. R. Raleigh, NC; North Carolina State Univ. (1975). 147p. University Microfilms Order No. 76-2423.

Thesis (Ph. D.).

The elementary solutions of the transport equation are applied, along with certain invariance principles, to critical problems in reflected reactors in slab geometry. The solutions of the one-speed equation for a critical slab with an infinite reflector for isotropic and linearly anisotropic scattering and with a finite reflector for isotropic scattering are written in terms of Case's normal modes with arbitrary expansion coefficients. The continuity conditions at the interface are used with Chandrasekhar's scattering function to reduce the problems to singular integral equations for the slab expansion coefficients and the critical thicknesses. The orthogonality of the normal modes is then used to regularize these integral equations to produce expressions suitable for iteration. Very accurate numerical results for the critical thicknesses are achieved. The solution of the two-group equation for a critical slab with an infinite reflector for isotropic scattering is written in terms of normal eigenvectors with arbitrary expansion coefficients. The two-group scattering matrix and the continuity conditions are used to develop a singular integral matrix equation for the slab expansion coefficients and the critical half-thickness. (Diss. Abstr. Int., B)

32455 CORRELATION ANALYSIS IN REACTOR MEASURING TECHNIQUES. Wach, D. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Arch. Tech. Mess. Messtech. Prax.; No. 472, 85-90(May 1975). (In German).

7 figs.; 20 refs.

The most important practical possible applications of the correlation analysis in measuring techniques are: (1) determination of dynamic information without disturbance of the running process (determination of transmission functions from noise signals), (2) determination of overriden periodicities within stochastic measuring signals, (3) improvement of the informing signal-disturbance signal gap, (4) determination of travel time, and (5) identification of signal sources. (DE)

32456 KINETICS OF A SYSTEM OF COUPLED PULSE REACTORS. Kolesov, V. F.; Petrov, Yu. V.; Shtarev, S. K. At. Energ. (USSR); 39: No. 6, 392-396(Dec 1975). (In Russian).

Equations describing transient processes in a system of two coupled pulse reactors, as well as analytical and numerical solutions of these equations, are presented. The dependence of pulse characteristics on system input parameters has been investigated on the basis of obtained solutions. In particular, it is shown that in most cases pulse widths in components differ from one another by no more than a factor of 1.5; the relative shift of pulses in components does not exceed ⅓ of the pulse width; the pulse form in each component is characterized by a delayed decrease; and the ratio of fission rates in components changes sharply during the transient process. (1 figure, 14 references.) (auth)

32457 DISTRIBUTION OF TWO-PHASE FLOW THERMO-HYDRAULIC PARAMETERS OVER THE CROSS SECTION OF CHANNELS WITH ROD CLUSTERS. Mironov, Yu. V.; Shpanskii, S. V. At. Energy. (USSR); 39: No. 6, 403-408(Dec 1975). (In Russian).

A system of equations of hydraulic two-phase flow in rod clusters based on a sub-channel model is presented to analyze the effects of non-uniform distribution of thermohydraulic parameters over the cross-section of channels. Theoretical results and experimental data are compared. (5 figures, 12 references) (auth)

32458 MULTIDIMENSIONAL SPACE-TIME NUCLEAR-REACTOR KINETICS STUDIES. I. Theoretical. Buckner, M. R.; Stewart, J. W. (Savannah River Lab., Aiken, SC). Nucl. Sci. Eng.; 59: No. 4, 289-297(Apr 1976).

A direct, iterative method has been developed for the numerical solution of the transient few-group neutron diffusion and delayed precursor equations in three-dimensional, hex-z geometry. The method is shown to be numerically stable, and truncation errors are of order h^2. The results of numerical experiments as well as comparison with space-time experimental results indicate that the method is accurate and that three-dimensional calculations can be performed at reasonable computing costs. The method is incorporated as a JOSHUA module at the Savannah River Laboratory.

32459 MULTIDIMENSIONAL SPACE-TIME NUCLEAR-REACTOR KINETICS STUDIES. II. Experimental. Parks, P. B.; Baumann, N. P.; Currie, R. L.; Jewell, C. E. (Savannah River Lab., Aiken, SC). Nucl. Sci. Eng.; 59: No. 4, 298-310(Apr 1976).

Experimental data that test the validity of a numerical solution of the transient few-group neutron diffusion and delayed precursor equations in two-dimensional hexagonal geometry are presented. The experiments involve free fall insertion of ^{235}U-bearing rods into an off-center location of a large critical, heavy-water-moderated lattice. The resulting transient flux tilts are strongly influenced by delayed neutron holdback. The calculated flux tilts agree with the measured flux tilts within the small uncertainty of the measurements. The data and input to the calculations are presented in sufficient detail to allow other methods of solution to be tested.

32460 APPLICATION OF COARSE-MESH REBALANCE ACCELERATION TO MONTE CARLO EIGENVALUE PROBLEMS. Asaoka, T.; Nakahara, Y.; Horikami, K.; Nishida, T.; Suzuki, T.; Taji, Y.; Miyasaka, S.; Hirota, J. (Japan Atomic Energy Research Inst., Tokai). Nucl. Sci. Eng.; 59: No. 4, 326-336(Apr 1976).

The coarse-mesh rebalance method is adopted in Monte Carlo schemes for aiming at accelerating the convergence of a source iteration process to obtain the eigenvalue of a nuclear reactor system. At every completion of the Monte Carlo game for one batch of neutron histories, the scaling factor for the neutron flux is calculated to achieve the neutron balance in each coarse-mesh zone. This rebalance factor is multiplied to the weight of each fission neutron in the coarse-mesh zone for playing the next Monte Carlo game. The numerical examples show that the present rebalance method gives a new usable sampling technique to get a better estimate of the number of neutrons lost or produced in each coarse-mesh zone by modifying the value obtained directly from the normal Monte Carlo calculation.

32461 THERMAL-REACTOR LATTICE ANALYSIS USING ENDF/B-IV DATA WITH MONTE CARLO RESONANCE REACTION RATES. Rothenstein, W. (Brookhaven National Lab., Upton, NY). Nucl. Sci. Eng.; 59: No. 4, 337-349(Apr 1976).

Uranium fueled thermal-reactor lattice benchmarks, as well as some other experimental assemblies, were analyzed with ENDF/B-IV data and calculational techniques based on integral transport and SN methods together with Monte Carlo calculations in the resolved resonance region. Only a relatively small overprediction of the ^{238}U resonance events—3 to 4 percent—remains when the present version of the ENDF/B data is used. It accounts for a considerable part of the 1 percent underprediction of criticality. Uranium-235 resonance absorption was found to be influenced noticeably by shielding due to the ^{238}U resonances. For both ^{235}U epithermal and ^{238}U fast fissions, the agreement between calculation and experiment, although relatively good, showed greater fluctuations than in the case of the ^{238}U capture. Calculated temperature variations of material buckling with temperature were greater than in the measurements, especially near room temperature, but the discrepancies were smaller in the critical than in the exponential assemblies.

32462 ENERGY GROUP STRUCTURES AND MINIMUM CRITICAL MASS. Jones, R. B.; Zweifel, P. F. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Nucl. Sci. Eng.; 59: No. 4, 429-436(Apr 1976).

The Goertzel reactor construct and the Goertzel–Wilkins theorem proved for this class of reactors are applied to a moderator fuel system at pressurized water reactor temperature and pressure conditions. The viability of the minimum critical mass as a global parameter to assess the integrity of energy group structures is investigated. The calculations are performed in diffusion and transport theory and up to eight energy groups are considered. Some initial guidelines based on the minimum critical mass for attaining nearly equivalent accuracy by using a fewer number of "properly" structured energy groups are discussed. Numerical results are still inconclusive but again suggest that transport theoretical calculations are pointless unless spectral codes that compute group constants include angular dependence.

32463 SUBCRITICAL REACTIVITY FROM POLARITY CORRELATION. Lung, T. P.; Ruby, L. (Univ. of California, Berkeley). Nucl. Sci. Eng.; 59: No. 4, 436-440(Apr 1976).

A generalization of Pacilio's method has been developed for utilizing two detectors to investigate reactor noise. The method requires only the measurement of the polarity of the detector output-current as compared with its average value, and therefore is of use in reactor systems with appreciable subcritical power. The modification extends the theory to the case in which the covariance can exceed unity. A unique bivariate negative binomial distribution is proposed for describing the correlated detectors, and a formula for the covariance-to-mean ratio is developed in terms of the polarity correlations between the detectors. From the ratio, the subcritical reactivity of the system can be determined.

32464 ALTERNATIVE MATERIALS FOR MICROFISSION TARGET PELLETS. Renken, J. H. (Sandia Labs., Albuquerque, NM). Nucl. Sci. Eng.; 59: No. 4, 442-444(Apr 1976).

The amounts of input energy required to trigger a microfission explosion in pellets made of hydrides and deuterides of both ^{239}Pu and ^{233}U have been estimated. The results indicate that these alternative fuels require significantly more trigger energy than pure ^{239}Pu.

32465 EFFECT OF STEP LENGTH ON THE SOLUTION TO NEUTRON BALANCE EQUATIONS BY DIFFERENCE METHOD. Fricova, I.; Dolasova, M. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). Fakulta Jaderna a Fysikalne Inzenyrska). Acta Polytech. (Prague), IV; No. 5, 123-128(1973). (In Czech).

From 2nd scientific conference of the Czech Technical University; Prague, Czechoslovakia (12 Jun 1973).

The application is described of a spatial differential approximation to the diffusion equation in one-dimensional geometry. The method was used in calculating the flux value for a homogeneous reactor with a reflector or for one without a reflector. The results obtained served the indication of the accuracy, applicability and economy of the method in individual cases. The χ^2 test was used in the evaluation of deviations. Also discussed is the calculation of neutron flux distribution on the reactor boundary using the so-called weighting method. (auth)

32466 STUDY ON HYDRAULIC CHARACTERISTICS OF TUBULAR SPACE OF HEAT-EXCHANGERS. Krapivin, A. M.; Bystrov, P. I.; Anofriev, G. I.; Mikhajlov, V. S.; Volovik, A. A. (Dnepropetrovskij Inst. Inzhenerov Zheleznodorozhnogo Transporta (Ukrainian SSR)). Teploenergetika (Moscow); No. 1, 58-61 (Jan 1975). (In Russian).

For English translation see the journal Therm. Eng.

32467 TIME-DEPENDENT STUDIES IN REACTOR THEORY. Subhash Chandra (Bhabha Atomic Research Centre, Bombay (India). Reactor Engineering Div.). pp 451-456 of Proceedings of the Indo-Soviet Seminar on Fast Reactors, Reactor Research Centre, Kalpakkam, December 6-8, 1972. Bombay; Department of Atomic Energy (1974).

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

An attempt has been made to review some of the analytical and numerical approaches developed or adopted to study the time behavior of reactor systems. These studies are, generally, intended to find out the reactor response in power, fuel temperature, coolant temperature, etc. under hypothetical perturbations with the object to determining the safe operating conditions of the reactor. In the present analysis point reactor kinetic equations are assumed to be valid. The dependence of reactivity function on temperature is neglected in analytical methods but is included in numerical methods. (auth)

32468 USE OF ^{252}Cf FISSION CHAMBER IN CERTAIN PHYSICAL MEASUREMENTS. Efimenko, V. F.; Mozhaev, V. K.; Dulin, V. A. Sov. At. Energy (Engl. Transl.); 39: No. 1, 628-630(Jul 1975).

Translated from At. Energ.; 39: No. 1, 54-56(Jul 1975).

The use of a ^{252}Cf fission chamber for measurements of reactivity and neutron lifetimes in reactors is discussed.

32469 LECTURE NOTES ON NUCLEAR POWER ENGINEERING. I. Reactor Physics. Bombay; Indian Institute of Technology (1974). 77p.

8 refs.

Lectures notes are presented on the topics atomic and molecular structure, neutron reactions, nuclear fission, reactor theory, critical size calculations and reactor control. The lectures were prepared for students taking a university level course in nuclear power engineering.

32470 PHYSIQUE DES REACTEURS NUCLEAIRES DE PUISSANCE. (Nuclear Power Reactor Physics). Barjon, R. (Grenoble-1 Univ., 38 (France)). Grenoble, France; Institut des Sciences Nucleaires (1975). 619p. (In French)

The purpose of this book is to explain the physical working conditions of nuclear reactors for the benefit of nonspecialized engineers and engineering students. One of the leading ideas of this course is to distinguish between two fundamentally different concepts: -a science which could be called neutrodynamics (as distinct from neutron physics which covers the knowledge of the neutron considered as an elementary particle and the study of its interactions with nuclei); the aim of this science is to study

the interaction of the neutron gas with real material media; the introduction will however be restricted to its simplified expression, the theory and equation of diffusion; -a special application: reactor physics, which is introduced when the diffusing and absorbing material medium is also multiplying. For this reason the chapter on fission is used to introduce this section. In practice the section on reactor physics is much longer than that devoted to neutrodynamics and it is developed in what seemed to be the most relevant direction: nuclear power reactors. Every effort was made to meet the following three requirements: to define the physical bases of neutron interaction with different materials, to give a correct mathematical treatment within the limit of necessary simplifying hypotheses clearly explained; to propose, whenever possible, numerical applications in order to fix orders of magnitude. (FR)

32471 DEVELOPMENT OF IMPROVED DATA ANALYSIS METHODS FOR REACTIVITY MEASUREMENTS IN LARGE THERMAL-POWER REACTORS. Ferguson, K. L.; Poncelet, C. G.; Impink, A. J. Jr. (Carnegie-Mellon Univ., Pittsburgh). Nucl. Technol.; 29: No. 1, 37-52(Apr 1976).

A current widespread procedure relies on the use of a reactivity meter for differential control rod measurements in nuclear reactors. From an observational point of view, the reactivity meter will measure the correct core reactivity if the input to the meter is proportional to the neutron amplitude function. A single detector reading is generally proportional to the amplitude function only if the point kinetics approximation is valid, that is, if the spatial flux distribution is invariant in time. Results of numerical simulations show that small spatial deviations can lead to large errors in reactivity determinations in current thermal-power reactor designs. In going from the use of single point to single long detector schemes, errors in reactivity determination are decreased but not eliminated and are very dependent on control rod location detector position. An integral approach has been developed and evaluated for a wide variety of core conditions for the reconstruction of the amplitude function from a set of detector readings. The scheme developed uses only observed detector readings and results in a combination of improved, consistent accuracy and ease of data handling.

32472 MULTIVARIATE STATISTICAL PATTERN RECOGNITION SYSTEM FOR REACTOR NOISE ANALYSIS. Gonzalez, R. C.; Howington, L. C.; Sides, W. H. Jr.; Kryter, R. C. (Oak Ridge National Lab., TN). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 342-349(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A multivariate statistical pattern recognition system for reactor noise analysis was developed. The basis of the system is a transformation for decoupling correlated variables and algorithms for inferring probability density functions. The system is adaptable to a variety of statistical properties of the data, and it has learning, tracking, and updating capabilities. System design emphasizes control of the false-alarm rate. The ability of the system to learn normal patterns of reactor behavior and to recognize deviations from these patterns was evaluated by experiments at the ORNL High-Flux Isotope Reactor (HFIR). Power perturbations of less than 0.1 percent of the mean value in selected frequency ranges were detected by the system.

32473 GENERAL METHOD FOR GENERATING EFFECTIVE RESONANCE CROSS SECTIONS FOR HETEROGENEOUS MEDIA. Kirby, K. D.; Karam, R. A. (Georgia Inst. of Tech., Atlanta). Nucl. Sci. Eng.; 59: No. 3, 215-230(Mar 1976).

Effective resonance cross sections used in the analysis of heterogeneous reactors have generally been obtained through the use of equivalence theory and/or integral transport theory. One fundamentally restrictive assumption common to equivalence theory and most integral transport methods is the flat-source approximation. The assessment of this approximation was recently completed and comprised the following: (1) comparison of the broad-group cross sections of ^{238}U in the resolved resonance region using (a) the flat-source approximation, (b) the exact source distribution, and (c) the rational approximation with a Levine-type factor; (2) comparisons for a typical zero power reactor (ZPR) assembly, a liquid-metal fast breeder reactor commercial power station, and a light-water power reactor. The main conclusion was that even though there were significant differences between the exactly calculated escape probabilities and those calculated with the flat-source approximation, additional differences between the general energy-dependent reciprocity and the energy-independent (but often erroneously applied as energy-dependent) reciprocity relation almost completely compensated for the error in the flat-source escape probabilities. Due to this unusual and somewhat unexpected compensating effect, the effective capture cross sections of ^{238}U in the resolved resonance region, generated by the three methods stated above, were essentially the same.

32474 ACCURACY OF THE QUASISTATIC METHOD FOR TWO-DIMENSIONAL THERMAL REACTOR TRANSIENTS WITH FEEDBACK. Dodds, H. L. Jr. (E. I. du Pont de Nemours, Aiken, SC). Nucl. Sci. Eng.; 59: No. 3, 271-281(Mar 1976).

The quasistatic method was compared with a direct finite difference method of solving two-dimensional thermal reactor transient problems with thermal-hydraulic feedback. Calculations using both methods were performed for a cylindrical (r-z), D_2O-moderated and -cooled uranium-fueled reactor. This study shows that the quasistatic method is capable of producing highly accurate results, relative to the direct finite difference method, for two-dimensional thermal reactor transients with feedback. The quasistatic method also offers the flexibility of using larger time steps between flux shape calculations, without encountering numerical problems, than the direct method. The quasistatic and direct method codes used in this work are comparable with respect to accuracy and computing costs for the subprompt critical transients considered in this work except for transients with weak spatial effects. For such transients, much larger time steps can be used in the quasistatic code than in the direct method code to achieve a specified accuracy, which, in turn, provides a considerable savings in computing costs.

32475 NEUTRON CROSS SECTIONS IN THE RESONANCE ENERGY REGION FOR SOLUTION OF THE PROBLEM ON NEUTRON TRANSFER BY THE MONTE CARLO METHOD. Naumov, V. A.; Rozin, S. G.; Fridman, E. G. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 8-12(1975). (In Russian)

A description of an algorithm for treatment of the resonance energy regions to calculate the reactor systems by the Monte-Carlo method is given. For illustration mean cross sections of radiation capture within energy intervals of about 0.5 keV are calculated.

32476 CALCULATION OF REACTOR CELLS IN THE ALLOWED RESONANCE REGION BY THE MONTE CARLO METHOD. Naumov, V. A.; Rozin, S. G.; El'perin, T. I.; Kozhinov, A. G. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 13-20(1975). (In Russian)

A physical algorithm is described for predicting a heterogeneous reactor cell by using the Monte-Carlo method within the resolved resonance region as a continuous function of neutron cross sections on energy. The predicted results are compared with the similar data obtained by the R. D. Richwyer program.

32477 DETERMINATION OF THE ALBEDO IN MODERATORS CONTAINING A LARGE SPHERICAL CAVITY. Stanolov, A.; Ilieva, K.; Khristov, V. (Inst. of Nuclear Research and Nuclear Power Engineering, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 7, 899-902(1975). (In Russian)

Two formulas for the calculation of the albedo in moderators were derived. The constants of the quasi-asymptotic attenuation of the neutron flux were determined experimentally and used in the solution of both equations. The results indicate relatively good agreement between the two formulas. (JSR)

Reactor Components and Accessories

Refer also to abstracts 28822, 29257–29260, 30049, 30066, 30067, 30086, 30129, and 32377.

32478 (AED-CONF-75-512-001) QUALITY ASSURANCE IN THE PLANNING AND CONSTRUCTION OF COMPONENTS FOR NUCLEAR POWER PLANTS AND LARGE CHEMICAL PLANTS. Doerling. (Steinmueller (L.u.C.) G.m.b.H., Gummersbach (F.R. Germany)). 1975. 19p. (In German). INIS.

From Steinmueller lecture meeting 75; Gummersbach, F.R. Germany (22 May 1975).

10 figs. With abstract.

High safety technical requirements must be demanded of the components of these plants to avoid economic hazards and to protect life and health. These requirements necessitate that each phase of the task completion, i.e., planning, construction, fabrication and assembly, be carried out systematically and totally in order to produce a component with optimum quality. Quality assurance cannot then merely be a quality control in a conventional sense carried out during fabrication. It is much more a procedure which is oriented to the functional requirements of the components – or rather to the function carrier. (DE)

32479 (AED-CONF-75-541-000, pp v) THE PERFORMANCE OF THE WHOLE PLAN PRESTRESSED CONCRETE REACTOR

PRESSURE VESSELS AS VIEWED BY THE PROJECT CONTRACTOR. Bunke, N. 1975. (In German).

From conference on research and development in the field of prestressed-concrete reactor pressure vessels; Berlin, F.R. Germany (13 Oct 1975).

1 fig.; with app.

In prestressed-concrete reactor pressure vessels. Vol. 1. Introduction: Design-oriented research and development. (Deutscher Ausschuss fuer Stahlbeton, Berlin (F.R. Germany)).

Financial support by the Federal Government has been given for the development work on prestressed-concrete reactor pressure vessels in the FRG since 1969. The present work describes the aim, organization, chronological realization, and mutual assigning of the individual subjects of this project.

32480 (AED-CONF-75-541-000, pp v) SURVEY ON THE DEVELOPMENT WORK OF THE RUHR UNIVERSITY BOCHUM FOR PRESTRESSED-CONCRETE PRESSURE VESSELS. Zerna, W. 1975. (In German).

From conference on research and development in the field of prestressed-concrete reactor pressure vessels; Berlin, F.R. Germany (13 Oct 1975).

In prestressed-concrete reactor pressure vessels. Vol. 1. Introduction: Design-oriented research and development. (Deutscher Ausschuss fuer Stahlbeton, Berlin (F.R. Germany)).

The "research group on reactor pressure vessels" has existed for several years at the Institute for Constructive Engineering of the Ruhr University, Bochum. The research results obtained are given in numerous reports and publications. In the following report, a comprehensive survey is given on the work of the research group.

32481 (AED-CONF-75-541-000, pp v) THEORETICAL INVESTIGATIONS TO DETERMINE THE DEFORMATIONS IN LINERS WITH NON-LINEARITY OF THE MATERIAL PROPERTIES AND OF THE ANCHOR CHARACTERISTICS. Oberpichler, R. 1975. (In German).

From conference on research and development in the field of prestressed-concrete reactor pressure vessels; Berlin, F.R. Germany (13 Oct 1975).

In prestressed-concrete reactor pressure vessels. Vol. 1. Introduction: Design-oriented research and development. (Deutscher Ausschuss fuer Stahlbeton, Berlin (F.R. Germany)).

The present contribution contains a few theoretical investigations on liner behavior. Parametric studies were carried out of various influences which result from the choice of anchor characteristics and post-buckling rupture behavior as well as the buckling shape. Two-dimensional rupture behavior on a plane computer model is included taking account of non-linear material behavior and non-linear anchor characteristics.

32482 (BNL-50480) INTERGRANULAR STRESS CORROSION CRACKING OF SENSITIZED STAINLESS STEEL. First Quarterly Progress Report, July 1–September 30, 1975. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. Contract E(30-1)-16. 4p. Dep. NTIS $4.50.

Work performed in the program described is aimed at providing a better understanding of the chemical, metallurgical and electrochemical factors that cause intergranular stress corrosion to develop in the heat-affected zones of welds in stainless steels exposed to reactor coolants containing oxygen. The overall program goal is to provide the NRC with guidance in determining which combinations of material chemistry and water chemistry will render the material susceptible to this type of attack, and to develop a means of testing for the corrosion susceptibility of weld-sensitized stainless steels. The principal research tools are an electrochemical potential scanning probe developed at BNL several years ago and constant strain rate stress corrosion testing equipment. Principal efforts during this initial portion of the program have been directed towards renovation of the scanning electrochemical probe apparatus and of a laboratory to house the work and towards assembling a staff.

32483 (COO-2392-1) SITE AND DESIGN TEMPERATURE RELATED ECONOMICS OF NUCLEAR POWER PLANTS WITH EVAPORATIVE AND NON-EVAPORATIVE COOLING TOWER SYSTEMS. Sebald, J. F. (Gilbert Associates, Inc., Reading, Pa. (USA)). Jan 1976. Contract E(11-1)-2392. 419p. Dep. NTIS $11.00.

A comprehensive cost and evaluation study is presented which has been conducted for nuclear power plants using cooling systems which employ either evaporative or non-evaporative cooling tower types. The primary purpose of the study is to develop the economics for two 1000 MW(e) light water reactor power plants, one built on a site requiring non-evaporative cooling, the other built on a site where sufficient water is available to support the requirements of evaporative cooling systems. The study, while specific to two sites selected in New York State by the New York State Energy Research and Development Authority, is also of a general nature so that it may be applied to other locations. It takes into account essential variables such as ambient temperature, water availability, water cost, railway and highway accessibility, proximity to electric load centers, and normal ecological restraints specific to the two sites.

32484 (ISD-137) FINITE ELEMENTS FOR THE CALCULATION OF PRESTRESSED-CONCRETE REACTOR PRESSURE VESSELS. Argyris, J. H.; Faust, G.; Roy, J. R.; Szimmat, J.; Warnke, E. P.; William, K. J. (Stuttgart Univ. (TH) (F.R. Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen). 1973. 99p. (In German). INIS.

The present report is subdivided into three parts dealing with the underlying finite element theory, associated software design concepts, and application of the program system SBB for the analysis of prestressed concrete reactor vessels. The first part briefly reviews some of the basic concepts of the finite element method in regard to the analysis of three-dimensional composite solids. This summary is followed by a discussion of different finite elements which are available for idealization of various structural components in a prestressed concrete reactor vessel within the scope of three-dimensional, planar, or axisymmetric analysis. The second part mainly concentrates on programming aspects and the user-oriented side. The description of the program and data organization is followed by a summary of the Choleski equation solver using hypermatrices and substructures. This section concludes with a brief presentation of the program usage and the pertinent input-output facilities. The third part illustrates the capabilities of the program for the solution of technical problems. A number of examples serve to document its diverse applicability including an extensive study of the THTR 1:5 scale pressure vessel model.

32485 DECISION-MAKING PROBLEMS ASSOCIATED WITH HIGH-CAPACITY POWER SYSTEMS. Adam, E.; Altmann, W.; Munser, H.; Schilg, G. (Tech Univ, Dresden, E Ger). Energietechnik; 24: No. 7, 282-289(Jul 1974). (In German).

Problems associated with the construction of steam turbines as well as the design of the thermal cycle, the steam generator and the safety enclosure for nuclear systems are considered. The necessity of providing data-coupling and computer-aided decision facilities is discussed. 11 refs.

32486 CLASS 1 NUCLEAR PIPING CODES: DISCREPANCIES OF MANDATORY VERIFICATIONS AND UNCERTAINTIES ON THEIR APPLICATION. Cesari, F. (CNEN, Bologna, Italy). Elettrotecnica; 61: No. 7, 581-590(Jul 1974). (In Italian with English Abstract).

The ASME Section III and USAS B31.7 are the only available codes for nuclear piping of Class 1. These codes are critically examined to find the correct methods for their application. A comparative analysis of fuel versus nuclear plant is offered. 17 refs.

32487 CALCULATION AND EXPERIMENTAL DETERMINATION OF THE DEFORMATION OF THE SUPPORTING SURFACE OF THE GASKET IN A SERIES OF HIGH PRESSURE FLANGES. Nerli, G.; Bertoni, G. (Univ di Pisa, Italy). Meccanica; 9: No. 2, 130-142(Jun 1974).

The results of an investigation into the elastic deformations of the supporting surface of the gasket in conical steel flanges of the UNI 6086-67 PN 250 series intended for butt welding are reported. The deformations of the supporting surface, induced by the tightening of bolts and by internal pressure, give rise to variations in the distribution of the pressure on the gasket, with adverse consequences on the joint seal, especially when the fluid in the piping is at very high pressure, when the fluid has a low molecular weight (e.g. helium), and when the gaskets are very rigid, as is the case with metal gaskets. In very heavy duty conditions, if leakage of the internal fluid is to be avoided, the maximum relative elastic displacements between the points of the supporting surface must be small.

32488 DEVELOPMENT OF THE COOLING SYSTEMS, HEAT USE AND THERMAL EFFICIENCY IN NUCLEAR POWER PLANTS. Bogh, P. (Motor-Columbus Ingenieurunternehmung A. G., Baden (Switzerland)). Kerntechnik; 17: No. 9/10, 433-439(Sep 1975). (In English, German).

2 figs.; 5 refs. Pre-report on the subject of technical meeting No. 7.

The cooling towers now in planning or under construction are tested for their advantages and disadvantages on various sites. The summary leads to the conclusion that, in consideration of the technical requirements as well as the need for environmental protection, the mixed dry-wet natural draft cooling tower might be the most promising compromise for the future. (DE)

32489 TRANSLATIONS: SAFETY CODES AND GUIDES. Edition, 5/75. Compilation of Information on the Reactor Pres-

sure Vessel Required for Examination Purposes in the Licensing Procedures of Nuclear Power Plants. Cologne; Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V. (1975). 12p.

32490 TRANSLATIONS: SAFETY CODES AND GUIDES. Edition 4/75. Compilation of Information on the Reactor Protection System Required for Examination Purposes in the Licensing Procedures of Nuclear Power Plants. Cologne; Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V. (1975). 6p.

32491 TRANSLATIONS: SAFETY CODES AND GUIDES. Edition 3/75. Compilation of the Information on the Containment Vessel Required for Examination Purposes in the Licensing Procedures of Nuclear Power Plants. Cologne; Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V. (1975). 14p.

32492 CONTINUOUS RADIOCHEMICAL ANALYSIS AND FISSION PRODUCTS IN A NUCLEAR REACTOR WATER COOLANT. Moskvin, L. N.; Zakharov, L. K.; Lont'ev, G. G.; Mel'nikov, V. A.; Orlenkov, I. S.; Slutskii, G. K. At. Energ. (USSR); 39: No. 6, 412-415(Dec 1975). (In Russian).

A method of continuous radiochemical analysis of fission products in a nuclear reactor water coolant is proposed. The analysis is based on a process of continuous bi-dimensional chromatographic component separation on several successively-arranged sorbent layers. The construction of the chromatographic installation provides for the use of an arbitrary number of sorbent layers of various selectivities. The conditions of bi-dimensional chromatographic separation of iodine, cesium, cerium, barium and strontium isotopes have been determined and their continuous separation from a model solution achieved. Iodine and cesium isotopes have been continuously separated from the water coolant of the Kurchatov MP-reactor main circuit. The results of practical verification of the method indicate that it is possible, in principle, to use it for the continuous control of the composition of rather complex media. (3 figures, 3 tables, 3 references) (auth)

32493 HYDROGEN EMBRITTLEMENT OF STEEL FOR VESSELS. Gerasimova, V. V.; Rivkin, E. Yu. At. Energ. (USSR); 40: No. 1, 40-45(Jan 1976). (In Russian)

A model of the hydrogen embrittlement process has been proposed to calculate: for irreversible hydrogen embrittlement, the time required to accumulate an amount of hydrogen capable of resulting in the development of a crack, according to the Griffits correlation; for reversible hydrogen embrittlement, the time required for complete braking of migrating dislocations, as a consequence of which a plane of their accumulation forms. Based on data from the literature, the authors have calculated the concentration of hydrogen in metal and the equilibrium pressure in the collector. It has been shown that the estimate of the tendency of materials to hydrogen embrittlement at 300° C is incorrect by tests on galvanic hydrogenized speciments at room temperature. Mechanical linear destruction permits one to estimate that hydrogen embrittlement decreases the destructive tension by 10-13%.

32494 CONTAINMENT LEAK RATE TESTING: WHY THE MASS-PLOT ANALYSIS METHOD IS PREFERRED. Fleshood, D. L. Power Eng.; 80: No. 2, 56-59(Feb 1976).

Three methods of containment leak rate testing were employed simultaneously by the Carolina Power and Light Co. on the Brunswick and H.B. Robinson plants. The methods used were the mass-plot method, the point-to-point method, and the total time method. The methods are described, and results are presented which indicate the superiority of the mass-plot method. (DG)

32495 METHOD FOR DETERMINING RAPID DENSITY FLUCTUATIONS OF NUCLEAR REACTOR COOLANTS. Hiller, S. (to Siemens Aktiengesellschaft). US Patent 3,928,127. 23 Dec 1975. Priority Date 29 Sep 1972, German, Federal Republic of (F. R. Germany). 4p.

The nuclear reactor coolant flowing in a pipe is continuously irradiated by a nuclear radiation source and the ion absorbed component thereof is measured by means of a detector. The signals of the latter are fed, via an amplifier and a discriminator, to a multichannel analyzer in a multi-scaling circuit configuration with adjustable channel-switching frequency. Here, they are first stored and later transferred to an indicating or recording instrument for, preferably, automatic further processing.

32496 METHOD AND ARRANGEMENT OF DEHYDRATION AND DOSED SEPARATION OF SOLID MATERIALS. Siegismund, G.; Standke, S.; Beyer, G.; Czolbe, K. German(GDR) Patent 111,753/D/. 5 Mar 1975. 13p. (In German).

The device concerns a method and an arrangement for separation of solid materials, e.g., radioactive resins in nuclear power plants from water by means of filtration under pressure.

32497 IMPORTANCE OF NON-DESTRUCTIVE TESTING IN NUCLEAR INDUSTRY. Balaramamoorthy, K. (Bhabha Atomic Research Centre, Bombay (India). Atomic Fuels Div.). Electron. Today; 7: No. 8, 46-50(Aug 1974).

An attempt has been made to cover the varied types of nondestructive tests such as ultrasonics, eddy current, penetrating radiation and their present status as it relates to nuclear field. The importance, advancement and sophistication of nondestructive testing techniques acquired after the recent advances in the field of nuclear engineering and space technology are brought out. It is also pointed out that the methods used, the engineering techniques applied and the NDT required will all have to be developed to support the ever-increasing demand for nuclear power.

32498 POSSIBILITIES AND PROBLEMS OF FRACTURE MECHANICS. Bergemann, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Neue Huette; 19: No. 11, 671-675(Nov 1974). (In German).

A brief introduction into fracture mechanics is given and its limits are shown. Due to uncertainties of the geometric factor α problems arise in transferring values of the fracture toughness K_c obtained by laboratory measurements to actual dimensions. Likewise, the nondestructive detection of the actual crack size and the stress analysis are problematic so that a failure evaluation is complicated. Both the detectibility of stressed points by means of the stress analysis and efficient crack detection techniques are of practical importance for the safe operation of nuclear power plants, particularly for the reliability of the primary circuit of pressurized water reactors.

32499 WELDING FAILURES AND FRACTURE MECHANICS. Bergemann, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Schweisstechnik (Berlin); 24: No. 4, 146-149(Apr 1974). (In German).

The evaluation of welded joints, as far as the size and the frequency of welding failures is concerned, is carried out according to the conventional strength model, i.e., in conformity to the GDR standards TGL 10,646 sheet 1 and ASAO 880 item 1.5.5, concerning the relation between the permissible magnitude of error and the wall thickness. The influence of stress direction and geometry of plant components is not considered. Thus, in certain cases the actual strength behavior is reproduced incorrectly and even becomes reversed. Considering the results of fracture mechanics a proposal is made for the evaluation of failures particularly with regard to nuclear power plant components.

32500 ELECTRONICS IN NUCLEAR POWER PLANTS. Prabhakar, B. S. (Department of Atomic Energy, Bombay (India). Power Projects Engineering Div.). J. Inst. Electron. Telecommun. Eng.; 21: No. 4, 204-206(Apr 1975).

The vast use of electronic devices in the nuclear industry is explained. Advantages such as centralized control demanded by larger plants coupled with the reduced cost and improved reliability of instruments, etc. are mentioned. Their use in performing logic functions and performance calculations is also included. A brief outline of the future scope of these advanced techniques being used in power plants in India is also given.

32501 A TECHNIQUE OF PRESSURE MEASUREMENT IN LIQUID SODIUM. Loescher, K. (VEB Kraftwerksanlagenbau, Radebeul (German Democratic Republic)). Kernenergie; 18: No. 8, 249-251(1975). (In German).

Starting from some points of view to be observed when conceiving a procedure of pressure measurement in liquid sodium, a transducer is described which has been developed in pressure measurements in high-temperature media and liquid metals. Experimental and operational results are presented with their most essential information.

32502 TUBE BORE SURFACE DEFLECTION AND PROFILE MEASURING APPARATUS. Pettigrew, M. J. (to Atomic Energy of Canada Ltd., Ottawa, Ontario). Canadian Patent 941153. 5 Feb 1974. 10p.

Available from Commissioner of Patents, Ottawa.

Surface deflections and profiles of tube bores, particularly the bores of nuclear reactor pressure tubes, are measured by a reference beam having two fixed reference probes and a movable measuring probe between them. The reference beam is slidably and resiliently mounted within a tubular housing with the probes urged against the tube bore to be measured. Resiliently mounted wheels locate the tube housing within the tube bore to be measured. The movement of the measuring probe in relation to the fixed reference probes is recorded as the device passes through the tube and the recorded values used to establish a tube deflection profile.

32503 STEAM-GENERATOR TUBE FAILURES: WORLD EXPERIENCE IN WATER-COOLED NUCLEAR POWER REAC-

TORS IN 1974. Hare, M. G. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nucl. Saf.; 17: No. 2, 231-241(1976).

Steam-generator tube failures were reported at 25 of 59 water-cooled nuclear power reactors surveyed in 1974, compared to 11 of 49 in 1973. A summary is presented of these failures, most of which, where the cause is known, were the result of corrosion. Water chemistry control, inspection and repair procedures, and failure rates are discussed.

32504 REMOTE HANDLING RELATED TO POWER REACTORS: PANEL DISCUSSION. Conf. Remote Syst. Technol., Proc.; 22: 73-78(1974).

From 22nd conference on remote systems technology; Washington, DC, USA (Oct 1974).

The remote handling and maintenance facilities and problems are briefly reviewed for the Indian Point plant, high-temperature gas-cooled reactors, Experimental Breeder Reactor-II, and the Fast Flux Test Facility. (HDR)

32505 NON-DISMOUNTABLE SEALED CONNECTIONS. (to Bignier-Schmid-Laurent (BSL), 94- Ivry-sur-Seine (France)). French Patent 2,231,912/A/. 29 May 1973. 7p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention relates to a method for manufacturing a non-dismountable sealed convection between two conduits made of nonmutually weldable metals. The method is characterized in that it consists in assembling two plates, each of which being of a metal weldable to one of the two conduits, in centrally boring in these plates a circular hole of the same diameter with the conduit inner cross-section, and in that each conduit is welded to its respective plate, coaxially with the respective hole. This can be applied to conduits for the circulation of radioactive substances in the nuclear field. (FR)

32506 FRACTURE MECHANICS. Application to Pressure Vessels. Labbens, R. (Societe Creusot-Loire, 75- Paris (France)). pp 53-69 of National Colloquium on the Technology of Pressure Vessels. Paris, April 21-23, 1975. Vol. 1. Mechanics of Pressure Vessels. Senlis, France; Centre Technique des Industries Mecaniques (1975). (In French).

From national colloquium on the technology of pressure vessels; Paris, France (21 Apr 1975).

Fracture Mechanics introduces in the mechanics of solids surfaces along which displacements are discontinuous, or cracks, which result in singular solutions. The conditions for fast fracture, or crack instability, are expressed by writing that the strain energy released by a virtual extension of the crack is at least equal to the energy necessary to that extension. If calculations are limited to the first term, singular, of the stress field near the crack tip, the instability condition is written in terms of a unique parameter, the stress intensity factor, which depends on the load and geometry data. The conditions of validity of this theory are examined, with the introduction of a plastic strain zone near the crack tip, and the practical possibilities of fracture prediction. A particular application to pressure vessels is given, in plane strain for heavy walls, in plane stress for thin vessels. (FR)

32507 DIFFERENT ASPECTS OF THE APPLICATION OF ACOUSTIC EMISSION TECHNIQUES TO THE TECHNOLOGY OF PRESSURE VESSELS. Dumousseau, P. (Centre Technique des Industries Mecaniques (CETIM), 93- Saint-Ouen (France)). pp 75-90 of National Colloquium on the Technology of Pressure Vessels. Paris, April 21-23, 1975. Vol. 3. Technology of Pressure Vessels. Regulation and Specifications. Senlis, France; Centre Technique des Industries Mecaniques (1975). (In French).

From national colloquium on the technology of pressure vessels; Paris, France (21 Apr 1975).

Following a discussion of acoustic emission techniques, the plastic deformation of metals and its evolution towards fracture is studied. Work devoted to the industrial use of acoustic emission is surveyed: crack detection during welding and heat treatments; fracture forecasting (fracture by static overload, in-service fracture); defect localization. (FR)

32508 ELIMINATION OF THE RISK OF BRITTLE FRACTURE IN THICK WELDED PRESSURE VESSELS. Leymonie, C. (Alsthom, 90- Belfort (France)); Genevray, R. (Fives-Cail-Babcock, 75- Paris (France)). pp 269-292 of 17th Colloquium on Metallurgy. Mechanical and Metallurgial Factors of Fracture, Particularly in Nuclear Industry. Saclay, 24-26 June 1974. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French)

From 17th colloquium on metallurgy. Mechanical and metallurgical factors of fracture, particularly in nuclear industry; Saclay, France (24 Jun 1974).

The builder of welded pressure vessels faces the risk of brittle fracture throughout fabrication. He is forced to observe many precautions, in selecting the following: materials possessing good impact strength in the service conditions of the vessels; filler materials preventing transverse cracking of the welds: welding parameters preventing cold cracking. Fracture mechanics establish the relationships between material characteristics and critical defect size for a given set of service conditions. These principles must be expanded to increase the safety of thick pressure vessels. However, in order to derive maximum benefit, a major effort must be applied to increasing the effectiveness of nondestructive testing. (FR)

32509 METALLURGICAL FACTORS EXERTING AN INFLUENCE ON THE DUCTILITY OF STRUCTURAL STEELS. Dollet, J. (Societe Creusot-Loire, 75- Paris (France)). pp 293-379 of 17th Colloquium on Metallurgy. Mechanical and Metallurgical Factors of Fracture, Particularly in Nuclear Industry. Saclay, 24-26 Jun 1974. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French).

From 17th colloquium on metallurgy. Mechanical and metallurgical factors of fracture, particularly in nuclear industry; Saclay, France (24 Jun 1974).

The industrial means which can be employed by the metallurgist to improve the ductility of steels are described. Carbon and alloy steels (less than 10% of alloy additions) are studied. Changes in ductility characteristics are observed, especially impact strength and NDT (Nil Ductility Temperature), as a function of fabrication factors: production process, fabrication (rolling, forging), heat treatment, welding, stress relief heat treatment etc. (FR)

32510 INTERNAL AND GASEOUS HYDROGEN EMBRITTLEMENT. Fidelle, J. P.; Arnould-Laurent, R.; Roux, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92- Montrouge (France)); Lacombe, P. (Paris-11 Univ., 91- Orsay (France)). pp 437-518 of 17th Colloquium on Metallurgy. Mechanical and Metallurgical Factors of Fracture, Particularly in Nuclear Industry. Saclay, 24-26 June 1974. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French)

From 17th colloquium on metallurgy. Mechanical and metallurgical factors of fracture, particularly in nuclear industry; Saclay, France (24 Jun 1974).

After discussing the various sources of introduction, the state and movement of hydrogen in metals, the different theories generally acknowledged concerning the various modes of HE (hydrogen embrittlement) are summarized, and the essential common points and secondary differences prevailing between embrittlement by internal hydrogen and embrittlement by gaseous hydrogen are discussed. Then the problem of test methods, the various aspects of HE and the different factors affecting them are considered. The problem of protection against hydrogen absorption and HE is discussed. The role of HE in stress corrosion cracking is briefly dealt with. (FR)

32511 INFLUENCE OF STRESS, HEAT TREATMENT, AND COUPLING ON INTERGRANULAR STRESS CORROSION CRACKING OF INCONEL 600 AND X 750. Blanchet, J.; Coriou, H.; Grall, L.; Mahieu, C.; Pelras, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Chimie Appliquee). pp 519-557 of 17th Colloquium on Metallurgy. Mechanical and Metallurgical Factors of Fracture, Particularly in Nuclear Industry. Saclay, 24-26 June 1974. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French).

From 17th colloquium on metallurgy. Mechanical and metallurgical factors of fracture, particularly in nuclear industry; Saclay, France (24 Jun 1974).

Following a survey of the different investigations carried out on stress corrosion cracking in alloys of the inconel 600 type in water at elevated temperature, the influence of the following parameters is discussed: stress, heat treatment, coupling, grain size, microstructure. The mechanism of cracking is considered in the light of a hypothesis linked to the presence of sulfur compounds in the alloy. (FR)

32512 STRESS CORROSION OF U ALLOYS. Nomine, A. M.; Bedere, D.; Miannay, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). pp 559-615 of 17th Colloquium on Metallurgy. Mechanical and Metallurgical Factors of Fracture, Particularly in Nuclear Industry. Saclay, 24-26 June 1974. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French)

From 17th colloquium on metallurgy. Mechanical and metallurgical factors of fracture, particularly in nuclear industry; Saclay, France (24 Jun 1974).

Uranium-molybdenum alloys with body-centered cubic structure are subject to stress corrosion in air at room temperature. This phenomenon is observed particularly during tensile tests and during toughness measurements above a critical velocity. The investigation of initiation, propagation and sudden fracture phases shows that stress corrosion depends on several structural parameters, and falls with increasing molybdenum content. Ternary addition elements such as titanium and zirconium have no influence on resistance to crack propagation. Tests conducted in different environments show that stress corrosion is the same in water and in air, but that the crack velocity increases with moisture content. In oxygen, the stress corrosion decreases and the crack velocity is very low. In nitrogen, the material is not embrittled. Test results in hydrogen are given. The morphology of cracking is described. Theories of fracture of a brittle film and of embrittlement can cover these observations. (FR)

32513 INITIATION OF FATIGUE CRACKS. Bathias, C.; Sertour, G. (Societe Nationale Industrielle Aerospatiale, 75- Paris (France)). pp 647-676 of 17th Colloquium on Metallurgy. Mechanical and Metallurgical Factors of Fracture, Particularly in Nuclear Industry. Saclay, 24-26 June 1974. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French).

From 17th colloquium on metallurgy. Mechanical and metallurgical factors of fracture, particularly in nuclear industry; Saclay, France (24 Jun 1974).

In recent investigations of metal fatigue, crack initiation is generally distinguished from propagation. This distinction of the processes results from the application of fracture mechanics to fatigue cracking, an application which initially appeared more interesting for macroscopic propagation in phase II. At present, the tendency is to apply similar principles to the treatment of low crack velocities, and even the initiation phase. Following a survey of the initiation mechanisms suggested and the investigation techniques employed, particularly acoustic emission, an attempt is made to explain the mechanical aspect of crack initiation, by showing the influence of the shape accidents and crack propagation thresholds $\Delta K(s)$. (FR)

32514 INDUSTRIAL PREVENTION OF SUDDEN FRACTURE IN LARGE STRUCTURES. Labbens, R. (Societe Creusot-Loire, 75- Paris (France)). pp 763-810 of 17th Colloquium on Metallurgy. Mechanical and Metallurgical Factors of Fracture, Particularly in Nuclear Industry. Saclay, 24-26 June 1974. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French).

From 17th colloquium on metallurgy. Mechanical and metallurgical factors of fracture, particularly in nuclear industry; Saclay, France (24 Jun 1974).

Sudden fracture, not preceded by significant strain, is a well known phenomenon which has become more widespread with increasing dimension and service stresses. Protection was first achieved by attempting to determine the transition from cleavage fracture to ductile fracture, by observing the transition temperature of the energy absorbed by the fracture of a notched specimen. Above the transition point, the energy required for the split is higher, and the latter cannot practically occur without significant strain. This method is derived from observations, and not from mechanical analysis. Some materials do not exhibit this transition in fracture. The linear elastic theory of fracture, developed for them, is a mechanical study of the instability conditions of a crack. It has been extended to other materials, in their brittleness region, below their transition point, and sometimes above the latter, if the unit dimensions are large enough. The validity limits of the linear elastic theory are reached fairly rapidly for standard materials with good ductility. The theory has been extended into the mainly plastic zone and a beginning has been made with respect to industrial applications in these conditions. (FR)

32515 APPLICATION OF FRACTURE MECHANICS IN U. K. PRESSURE VESSEL PRACTICE. Nichols, R. W. (UKAEA Reactor Group, Risley). pp 813-825 of 17th Colloquium on Metallurgy. Mechanical and Metallurgical Factors and Fracture, Particularly in Nuclear Industry. Saclay, 24-26 June 1974. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975).

From 17th colloquium on metallurgy. Mechancial and metallurgical factors of fracture, particularly in nuclear industry; Saclay, France (24 Jun 1974).

The use of linear elastic fracture mechanics (LEFM) for analysis of critical defect sizes in thick-walled nuclear vessels is now well established. Problems arise with tougher materials and thinner sections where LEFM is less valid: recent developments in the application of fracture mechanics in such cases (COD, J. and equivalents energy methods) will be discussed. The use of these concepts in current revisions of British Standards will be described and their implications on inspection and test procedure discussed. (FR)

32516 PROPAGATION AND INSTABILITY OF NON-TRAVERSING CRACKS IN DUCTILE STRUCTURES. Dufresne, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. de Surete Nucleaire). pp 87-103 of National Colloquium on the Technology of Pressure Vessels. Paris, April 21-23, 1975. Vol. 1. Mechanics of Pressure Vessels. Senlis, France; Centre Technique des Industries Mecaniques (1975). (In French)

From national colloquium on the technology of pressure vessels; Paris, France (21 Apr 1975).

The behavior of non-traversing crack in a ductile strain-hardenable material used in relatively thin structures is analyzed. The investigations dealt with the growth of cracks under the effect of fatigue and creep, and with the determination of critical conditions leading to fracture of the ligament. The principle of the method used involves localizing and then virtually eliminating the portions of the structure in a plastic state, followed by treatment of the remaining portion by means of standard elasticity equations, by imposing appropriately limited conditions at the boundaries of the eliminated plastic regions. (FR)

32517 IMPROVEMENTS IN PUMPING INSTALLATIONS. Boussuges, P. (to Alsthom, 75- Paris (France)). French Patent 2,240,651/D/. 8 Aug 1973. 6p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The pumping installation comprises a helico-centrifugal pumping group constituted by an electric motor contained in a fluid tight bulb located in the outlet conduit, the shaft of said motor being directly coupled to a helico-centrifugal pump with fixed or adjustable blades, or vanes, in the inlet of which is mounted a section cone. The arrangement according to the invention is applicable in particular to high power refrigeration installations. (FR)

32518 HANDLING HOOK. Ventre, E.; Foucault, M. (to Electricite de France, 75- Paris). French Patent 2,241,483/E/. 24 May 1973. 6p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

This hook is characterized in that each hollow suspension-rod contains a heating resistor insulated from the ambient atmosphere and connected to current-supply terminals. This can be applied to the handling of fuel-elements or fuel assemblies in a nuclear reactor. (FR)

32519 MALFUNCTIONS OCCURRING IN STEAM AND SUPERHEATED WATER GENERATORS. Observations on the Construction and Equipment of These Generators. Heron, C. H. (Association Normande des Proprietaires d'Appareils a Vapeur et Electriques (A.P.A.V.E.), 76- Mont-Saint-Aignan (France)). pp 57-74 of National Colloquium on the Technology of Pressure Vessels. Paris, April 21-23 1975. Vol. 3. Technology of Pressure Vessels. Regulation and Specifications. Senlis, France; Centre Technique des Industries Mecaniques (1975). (In French)

From national colloquium on the technology of pressure vessels; Paris, France (21 Apr 1975).

This study is based on statistical data concerning malfunctions occurring in 1970 in steam and superheated water generators, forming part of a group of about 13,500 generators. These statistics are classified into main causes of accidents, and by type of generators. (FR)

32520 COMPUTATION RULES FOR PRESSURE VESSELS. Scope of SNCT, ASME – Section VIII, Division 1 and BS1515 Codes. Pellissier Tanon, A. (Societe Creusot-Loire, 75- Paris (France)). pp 25-36 of National Colloquium on the Technology of Pressure Vessels. Paris, April 21-23, 1975. Vol. 1. Mechanics of Pressure Vessels. Senlis, France; Centre Technique des Industries Mecaniques (1975). (In French).

From national colloquium on the technology of pressure vessels; Paris, France (21 Apr 1975).

The mechanical basis of computation methods employed in SNCT, ASME – Section VIII, Division 1 and BS1515 codes is analyzed. The behavior of pressure vessels can be essentially deduced from the analysis of behavior under pressure of spheres and cylinders, and of their joint zones. Design criteria also form a part of the technical conditions which must be satisfied to guarantee the safety and satisfactory operation of pressure vessels. The safety standpoint is dealt with by evaluating the computation codes with respect to methods associated with the determination of damage appearance thresholds. This study provides indication for the selection of suitable computation methods, as a function of vessel shape and type of loading. (FR)

32521 *DRIER UNIT FOR STEAM SEPARATORS.* Peyrelongue, J. P. (to Societe Stein Industrie, 75- Paris (France)). French Patent 2,234,917/A/. 27 Jun 1973. 10p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

Description is given of a drier unit adapted to equip a water separator mounted in a unit for treating a wet steam fed from a high pressure enclosure, so as to dry and contingently superheat said steam prior to injecting same into a turbine low pressure stage. This drier unit is constituted by at least a stack of separating sheets maintained in parallel relationship and at a slight angle with respect to the horizontal so as to allow the water provided by wet steam to flow toward a channel communicating with a manifold, and by means for guiding the steam between the sheets and evenly distributing it. This can be applied to steam turbines in nuclear power stations. (FR)

32522 ACCUMULATION OF RADIOACTIVE CORROSION PRODUCTS IN NUCLEAR STEAM GENERATORS. Lister, D. H. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1976). 102p. $1.50.

A mathematical model is developed describing contamination of nuclear boiler tubes by radioactive corrosion products, based on corrosion and diffusion mechanisms occurring at the tube surface, coupled with precipitation due to cooling. Model agrees with results of kinetic experiments in a pressurized water loop. (Corros. Abstr.)

32523 CRYOGENICS AND NUCLEAR POWER. Stuart, R. W. (CTI Nuclear, Inc., Waltham, MA). pp 61-69 of Advances in Cryogenic Engineering. Volume 20. New York; Plenum Press (1975).

From cryogenic engineering conference; Atlanta, Georgia (USA) (8 Aug 1973).

The paper discusses several current applications of cryogenics in the nuclear power industry. These applications lie chiefly in the line of gas services within the reactor: supply, purification, separation, or other special gas treatments. Several schemes for noble gas separation on the principle of cryogenic selective adsorption are described. A system using cryogenic adsorption to remove impurities in helium used as heat transfer medium in some reactors is shown. Some basic facts on the growth, problems, and costs involved in the development of nuclear power are briefly reviewed for the benefit of the cryogenic designer working on nuclear power projects.

32524 CHARACTERIZATION OF IRRADIATED FUEL RODS USING PULSED EDDY-CURRENT TECHNIQUES. Martin, M. R.; Francis, W. C. (Aerojet Nuclear Co., Idaho Falls, ID). Conf. Remote Syst. Technol., Proc.; 23: 316-328(1975).

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975). See CONF-751115-.

A pulsed eddy-current (PEC) system was used in the remote nondestructive examination of 100 irradiated fuel rods and unfueled cladding tubes. The examination was carried out by Aerojet Nuclear Company as part of the water reactor safety program. Two fuel rods and one cladding tube were destructively examined to correlate the PEC defect indications with actual phenomena. The PEC equipment, designed jointly by Argonne National Laboratory and Aerojet, performed the functions of diametral, bowing, and wall-thickness measurements and od and id surface defect detection very satisfactorily. (auth)

32525 ACOUSTIC EMISSION ANALYSIS OF STRESS CORROSION CRACKING IN TYPE 304 STAINLESS STEELS. Brihmadesam, J. S.; McCormick, N. J. (Univ. of Washington, Seattle). Nucl. Technol.; 29: No. 1, 127-135(Apr 1976).

Past experiments to demonstrate the feasibility of using acoustic emission analysis to detect stress corrosion crack growth during proof testing have been performed for Type 304 stainless steel. There was little or no acoustic emission at operating stress levels, where the operating stress intensity factor was 58.0 ksi $in.^2$, but emission increased to a maximum at the proof stress intensity factor of 73.0 ksi $in.^2$ for specimens that were given stress relief anneal and at a proof stress intensity factor of 102.0 ksi $in.^2$ for specimens heat treated at higher temperatures.

32526 GENERAL DESIGN CRITERIA FOR DIESEL-GENERATOR SETS FOR NUCLEAR POWER PLANTS. Rangarao, G. (Ebasco Services Inc., New York). IEEE Trans. Power Appar. Syst.; PAS-94: No. 4, 1358-1366(1975).

From Joint IEEE/ASME power generation technical conference; Miami Beach, FL, USA (15 Sep 1974).

The design criteria for diesel-generators for nuclear power plants are examined. Applicable standards, loading, design performance, and characteristics to be considered in the selection of diesel-generator set and its auxiliary system are discussed. Also, engineered safety features loads together with loss of power safe shutdown loads and their starting sequence, analysis of voltage and frequency response and the diesel-generator ability to start various load blocks successfully to meet the reactor emergency core cooling requirements are discussed.

32527 INCORPORATION OF SPECTRAL EFFECTS INTO ONE-GROUP NODAL SIMULATORS. Becker, M. (Rensselaer Polytechnic Inst., Troy, NY). Nucl. Sci. Eng.; 59: No. 3, 276-278(Mar 1976).

A simple analytical procedure has been developed for incorporating spectral effects into one-group nodal simulators. The procedure leads to good agreement with fine-mesh two-group diffusion calculations.

32528 USE OF "DRY" COOLING TOWERS FOR THE COOLING OF THE CONDENSERS OF NUCLEAR POWER PLANTS WITH DISSOCIATING COOLANTS. Mikhalevich, A. A.; Nesterenko, V. B.; Peslyak, V. I. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 21-23 (1975). (In Russian)

The influence of cooling water parameters on the cost index of water refrigeration system of Heller for large atomic power plants with dissociating working substance is analyzed.

32529 METHOD FOR THE DECONTAMINATION OF THE COOLANT N_2O_4 FROM RADIOIODINE. Drugachenok, M. A.; Gol'tsev, V. P.; Datskevich, P. I.; Kuznetsova, N. B.; Dolgov, V. M. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 37-39(1975). (In Russian)

The arrangement, conditions, and results of an experiment on decontamination of gaseous N_2O_4 from fragmental radioactive iodine with silica gel impregnated with $AgNO_3$ as sorbent are presented.

32530 EXPERIMENTAL DETERMINATION OF THE MEAN-BULK TEMPERATURES IN THE NON-ISOTHERMAL FLOW OF CHEMICALLY REACTING NITROGEN TETRAOXIDE. Devoino, A. N.; Kolykhan, L. I.; Stepanenko, V. N.; Tverkovkin, B. E.; Uyutov, G. I. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 99-105(1975). (In Russian)

The technique and results of an experimental investigation to determine bulk temperature values of cooled turbulent flow of chemically reacting N_2O_4 in a circular tube are considered. The applicability of the calculation technique of one-dimensional flow parameters of the investigated coolant is supported by the experience gained at the Institute of Nuclear Power Engineering of the BSSR Academy of Sciences.

Reactor Fuels

Refer also to abstract 32524.

32531 FUEL ELEMENTS FOR PROVEN POWER REACTOR SYSTEMS. Performance and Development. Knoedler, D. (Kraftwerk Union A. G., Erlangen (F. R. Germany). Bereich Brennelemente). Kerntechnik; 17: No. 9/10, 427-431(Sep 1975). (In German, English).

The state of research and technology in the development of commercial fuel elements in water-cooled reactors is discussed. The various designs in the important manufacturing firms in the USA and FRG are described. (DE)

32532 IN-REACTOR MEASUREMENTS OF URANIUM DIOXIDE'S MODULUS OF ELASTICITY. Baranov, V. M.; Bibilashvili, Yu. K.; Golovnin, I. S.; Kakurin, V. N.; Men'shikova, T. S. At. Energ. (USSR); 40: No. 1, 37-40(Jan 1976). (In Russian)

An ultrasonic system for in-reactor measurement of elastic characteristics of materials is described. The change of uranium dioxide's modulus of elasticity during irradiation with neutron flux densities of $1.7 \cdot 10^{11}$ and $5 \cdot 10^{12}$ $n/(cm^2 \cdot s)$ at temperatures of 90° C and 300° C, respectively, has been investigated. There have been observed small decreases in the modulus of elasticity during the initial period of irradiation and its subsequent increase when the fluence exceeds $0.6 \cdot 10^{17}$ n/cm^2. The observed changes are explained as due to the formation and migration of point defects arising under the action of irradiation.

32533 SHEATH FOR NUCLEAR FUEL ELEMENTS. Pawliw, J.; Zabrodsky, J. (to General Electric Co.). US Patent 3,928,130. 23 Dec 1975. Priority Date 27 Sep 1972, Canada. 4p.

A description is given of a nuclear fuel element for use in a nuclear reactor which is provided with a high strength sheath to limit the effects of forces acting internally and externally on the element when in service within a reactor.

32534 GRID STRUCTURE FOR NUCLEAR REACTOR FUEL ASSEMBLY. Wachter, W. J.; Akey, J. G. US Patent 3,928,131. 23 Dec 1975. Filed Date 24 Oct 1972. 6p.

Described is a nuclear fuel element support system comprising an egg-crate-type grid made up of slotted vertical portions interconnected at right angles to each other, the vertical portions being interconnected by means of cross straps which are dimpled midway between their ends to engage fuel elements disposed within openings formed in the egg-crate assembly. The cross straps are disposed at an angle, other than a right angle, to the vertical portions of the assembly whereby their lengths are increased for a given span, and the total elastic deflection capability of the cell is increased. The assembly is particularly adapted for computer design and automated machine tool fabrication.

32535 NONDESTRUCTIVE MEASUREMENTS IN NUCLEAR FUEL TECHNOLOGY. Rafanelli, C. Rass. Chim.; 26: No. 3, 159-164(May 1974). (In Italian).

Nondestructive testing techniques for the fissile materials are examined to be applied in fabrication of fuel elements. Gamma spectroscopy, neutron spectroscopy, emission spectroscopy and calorimetry applications are discussed and some practical results are reported.

32536 LECTURE NOTES ON NUCLEAR POWER ENGINEERING. II. Nuclear Fuels and Materials, Heat Generation and Heat Transfer in Nuclear Reactors. Bombay; Indian Institute of Technology (1974). 52p.

6 refs.

Lecture notes are presented on nuclear fuels and materials used for moderators, coolants, etc. in nuclear reactors, heat generation and heat transfer. The lectures were prepared for the students taking a university level course in nuclear power engineering.

32537 IMPROVED NONDESTRUCTIVE DETERMINATION OF TWO-DIMENSIONAL RADIAL ISOTOPIC DISTRIBUTIONS IN IRRADIATED FUEL PINS. Phillips, J. R. (Los Alamos Scientific Lab., NM). Nucl. Technol.; 28: No. 2, 282-290(Feb 1976).

The method for the nondestructive determination of two-dimensional radial isotopic distributions of fission and activation products of irradiated fuel pins was improved. In this method the fuel pins are gamma-scanned diametrally at two or more angular orientations, and the diametral isotopic scans are unfolded into two-dimensional radial isotopic distributions. The computer code for processing the data was improved so that it calculates the individual diametral volume segments, the source self-attenuation factors, and the source intensity matrices. The two-dimensional source intensity matrices are presented as radial isotopic distributions, density plots, contour plots, and isometric projections. The new computer code improves the precision and reduces the analysis time as shown in the examination of more than 10 experimental fast-reactor fuel pins.

32538 HIGH STRAIN CRACK GROWTH IN ZIRCALOY-2 WELDS. Solomon, H. D. (General Electric Co., Schenectady, NY). Nucl. Technol.; 29: No. 1, 86-93(Apr 1976).

The high strain crack growth rate in isotropic Zircaloy-2 welds was measured using strain cycling with controlled limits of plastic strain. The crack growth rate was found to be a function of the longitudinal plastic strain range or the longitudinal elastic strain range. This isotropic crack growth is compared to low cycle fatigue and crack propagation tests performed on the anisotropic starting material from which the welded specimens were fabricated. The behavior of the weldments was consistent with that observed in the anisotropic plates. The crack growth rate in the welds was between the upper and lower extremes measured with different orientations of the anisotropic plates.

32539 CALCULATION OF THE TEMPERATURE OF THE GAS FLOW OF THE CHEMICALLY REACTING SYSTEM N_2O_4 IN EQUILIBRIUM $2NO_2$ IN EQUILIBRIUM $2NO + O_2$ IN BULK FUEL ELEMENTS. Khorev, V. I.; Kolos, V. P. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 110-114(1975). (In Russian)

The radial gas flow model for fuel bed was suggested as approximation to create the technique of calculation of temperature field of gas flow taking into account the kinetics of chemical reactions.

32540 HEAT EXCHANGE DURING TURBULENT FLOW OF DISSOCIATING GAS N_2O_4 IN CHANNELS OF NON-CIRCULAR CROSS SECTION DURING VARIABLE HEAT EXCHANGE ALONG THE FLOW. Yakushev, A. P.; Tverkovkin, B. E.; Nesterenko, V. B.; Nemtseva, I. G. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 124-128(1975). (In Russian)

The problem of heat transfer by the turbulent flow of dissociated N_2O_4 in the rod bundles under condition of variable heat flux along the flow is considered. The expression for calculation of heat transfer is found and numerical results are given.

Reactor Control Systems

32541 (AEEW-R-1031) SUPPRESSION OF RELAY INTERFERENCE, WITH PARTICULAR REFERENCE TO NUCLEAR REACTOR SAFETY CIRCUITS. Phillips, P.; Cake, B. V.; Fowler, E. P. (UKAEA Reactor Group, Winfrith, Atomic Energy Establishment). Nov 1975. 21p. Dep. NTIS (US Sales Only) $3.50.

In recent years the maximum level of induced interference current which can normally be expected in instrumentation systems has been found to be in the region of 100mA rms. However, in the course of investigating interference problems, abnormally high levels, of as much as 20A peak, have been found to originate from relay circuit interruption. A likely coupling mechanism for this source of interference is discussed and analyzed and it is concluded that proper suppression of relays is practical, safe and beneficial.

32542 (INIS-mf-1967, pp 54-60) STUDY OF THE DYNAMIC BEHAVIOUR AND SAFETY OF NUCLEAR POWER PLANTS BY MEANS OF ON-LINE, REAL TIME NOISE SIGNAL ANALYSIS. Kemeny, L. G. 1973.

From conference on acoustic and vibration signal analysis; Sydney, Australia (6 Jul 1973).

In conference on acoustic and vibration signal analysis. (New South Wales Univ., Kensington (Australia). School of Physics).

An on-line reactor noise data acquisition system is described. Preliminary results obtained during the monitoring of the HIFAR reactor of the Australian Atomic Energy Commission are reported and discussed. The relationships between experimental measurements and basic stochastic models are explored.

32543 OPTIMAL CONTROL THEORY AS A BASIS OF NUCLEAR REACTOR CONTROL DESIGN. Aleksakov, G. N. At. Energ. (USSR); 39: No. 6, 397-399(Dec 1975). (In Russian).

Two interconnected parts of the system approach to nuclear reactor control design are considered: physical meaning of the optimal control processes in the reactor itself and interpretation of the achieved results as requirements for the technical characteristics of measuring, data processing and controlling devices which enable to produce the optimal or sub-optimal control processes. The theory is illustrated by the design of a specialized device for nuclear reactor state indication and optimal control. (3 figures, 4 tables) (auth)

32544 APPLICATION OF IN-CORE DIRECT CHARGE DETECTORS IN THE AUTOMATIC REGULATION SYSTEM OF NUCLEAR REACTORS. Mitel'man, M. G.; Andreev, L. G.; Batenin, I. V.; Dubovskii, B. G.; Zagadkin, V. A.; Lyubchenko, V. F. At. Energ. (USSR); 39: No. 4, 272-274(Oct 1975). (In Russian)

At the Obninsk atomic power station, an experiment in automatic regulation of the reactor using in-core direct charge rhodium detectors from the energy-release control system was performed. The system consisted of twelve integral direct charge detectors and two assemblies along the height of the core, each consisting of four detectors. Amplified detector signals were fed to a summing block in which the output signal was also corrected, taking into account the half-life period of rhodium and making the entire system inertialess. Experimental data indicating that the results of automatic regulation of the reactor from ionization chambers and from the above system agree within the limits of experimental accuracy are presented.

32545 THE ROLE OF THE PROCESS COMPUTER IN THE MONITORING OF PWR'S. Bock, H. W.; Sengler, G.; Zimmermann, M. (Kraftwerk Union A. G., Erlangen (F. R. Germany)); Zaiss, H. W. (Siemens A. G., Erlangen (F. R. Germany). Abt. Systemtechnische Entwicklung). Siemens Rev.; 41: No. 6, 255-259(Jun 1975).

The availability of fast and accurate data on the nuclear and thermodynamic performance of nuclear power stations offers the possibility of optimizing their safe and economic operation. The large amount of measuring data produced can be processed only with the aid of a digital computer. A special software system has been developed for the acquisition, evaluation and logging of data for light water moderated pressurized water reactors. (DE)

32546 PROCESS COMPUTERS IN NUCLEAR POWER STATIONS WITH PRESSURIZED-WATER REACTORS. Graf, G. (Kraftwerk Union A. G., Erlangen (F. R. Germany)); Haehle, E. (Siemens A. G., Erlangen (F. R. Germany). Abt. Systemtechnische Entwicklung). Siemens Rev.; 41: No. 6, 248-255(Jun 1975).

In nuclear power stations equipped with pressurized water reactors, process computers form the most important means of supervision of the various plant systems. They supply the operating personnel with basic information for the recognition

and diagnosis of disturbances as well as information for selecting the operating mode of the plant. The principal goal to be reached through the use of process computers is an increased availability of the plant. The information is based—especially on the reactor side—on characteristic data, which cannot be determined without computers. The task goals are achieved using proven standardized systems. (DE)

32547 RELIABILITY OF SAFETY RELATED ELECTRONIC EQUIPMENT FOR REACTOR INSTRUMENTATION. Bastl, W.; Gossner, S.; Nieckau, E. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Arch. Tech. Mess. Messtech. Prax.; No. 472, 81-84 (May 1975). (In German)

Reliability problems concerning reactor equipment protection are dealt with and constructive measures are discussed in association with the technical connecting of this equipment, which lead to a more reliable desired switching procedure on a system level. (DE)

32548 ON-LINE REACTOR SURVEILLANCE ALGORITHM BASED ON MULTIVARIATE ANALYSIS OF NOISE. Piety, K. R.; Robinson, J. C. (Univ. of Tennessee, Knoxville). Nucl. Sci. Eng.; 59: No. 4, 369-380(Apr 1976).

A minicomputer-based system for reactor surveillance was developed and demonstrated on-line. The state of the reactor is characterized by the system from an analysis of noise signals, and a surveillance algorithm statistically describes normal behavior from this characterization. Hyperellipsoids are constructed from this description to enclose normal regions of behavior in the multidimensional measurement space, which represents all possible reactor states. When measurements outside normal regions are detected, the status of the reactor is suspect. Tests at the High Flux Isotope Reactor demonstrate that the algorithm can sense changes in reactor conditions that the plant instrumentation cannot detect.

32549 AN IMPROVED MEASURING DEVICE FOR MONITORING BORON CONCENTRATION IN NUCLEAR REACTORS. Faehrmann, K.; Westphal, D. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Kernenergie; 18: No. 7, 216-220(1975). (In German).

A neutron-absorption-based measuring device for quasi-continuous determination of low boron concentrations in pressurized water reactors is described. High sensitivity of the device is obtained by continuously eliminating the deviations of the quantity to be measured due to changes in coolant density and drifts in the electronic circuits.

32550 AUTOMATIZATION OF THE STADE NUCLEAR POWER STATION CONTROL. Zelenetskij, Yu. V.; Sergievskaya, E. N.; Mal'tsev, B. K. (Comps.). Teploenergetika (Moscow); No. 1, 90-92(Jan 1975). (In Russian).

For English translation see the journal Therm. Eng.

32551 AUTOMATIC OPTIMIZATION OF THE CONTROL ROD CONFIGURATION IN POWER REACTORS. Schumacher, G. Magdeburg, Ger.; Technische Hochschule (1973). 92p. (In German). INIS.

Thesis. Available from the University Library, Berlin (German Democratic Republic).

32552 MECHANICAL ENERGY ABSORBING DEVICE ADAPTED TO RESUME ITS INITIAL STATE. Martin, J. (to Groupement pour les Activites Atomiques et Avancees (GAAA), 92- Le Plessis-Robinson (France)). French Patent 2,237,088/A/. 13 Jul 1973. 8p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

Device for absorbing the kinetic energy of a moving mass, combining the action of a helical spring with the viscoresilient deformation of a plastic material cylinder provided with a jacket is described. Under the action of the energy absorbed by the spring, said mechanical energy absorbing device comes back by itself to its initial state. This device can be applied to braking control rods in nuclear reactors. (FR)

32553 DISTRIBUTED CONTROL AND INSTRUMENTATION SYSTEMS FOR FUTURE NUCLEAR POWER PLANTS. Yan, G.; L'Archeveque, J. V. R. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 431-435 (Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

The centralized dual computer system philosophy has evolved as the key concept underlying the highly successful application of direct digital control in CANDU power reactors. After more than a decade, this basis philosophy bears re-examination in the light of advances in system concepts–notably distributed architectures. A number of related experimental programs, all aimed at exploring the prospects of applying distributed systems in Canadian nuclear power plants are discussed. It was realized from the outset that the successful application of distributed systems depends on the availability of a highly reliable, high capacity, low cost communications medium. Accordingly, an experimental facility has been established and experiments have been defined to address such problem areas as interprocess communications, distributed data base design and man/machine interfaces. The design of a first application to be installed at the NRU/NRX research reactors is progressing well.

32554 CALCULATION OF THE EFFICIENCY OF SEGMENTED REGULATORS AND ITS EXPERIMENTAL VALIDATION. Bolobov, P. A.; Orlova, E. M.; Romodanov, V. L.; Topil'skii, L. N.; Shishkov, L. K. Sov. At. Energy (Engl. Transl.); 38: No. 3, 212-213(Mar 1975).

Translated from At. Energ.; 38: No. 3, 168-169(Mar 1975).

One of the pressing problems of reactor design is to determine the efficiency of regulating elements of complex shape. It is possible to consider a specific geometry, but the diversity of real situations requires the development of different approximate methods. In a number of cases satisfactory results can be obtained by using the perturbation theory or its modifications. The possibility of experimental varification of a given approximation is of great interest. For nonbreeding media measurements by the method of pulsed neutron source are one of the means of possible experimental verification of the procedure of computing regulators of complex shape. Several advantages of this method are described. (auth)

32555 SYSTEM OF OPERATIVE COMPUTER CONTROL OF POWER DISTRIBUTION FIELDS IN BELOYARSK NUCLEAR POWER PLANT NO. 1. Kulikov, N. Ya.; Snitko, E. I.; Rasputnis, A. M.; Solodov, V. P. At. Energ. (USSR); 40: No. 2, 152-154 (Feb 1976). (In Russian)

The main design parameters and experimental data for the system of operative computer control of power distribution fields in the Beloyarsk Nuclear Power Plant No. 1 are presented. The application of the operative method made it possible to reduce the technological channel power calculation error in reactor II of the block by 5–6% and thus to increase the power of the block. The operative system makes it possible to maintain the reactor neutron field with a relative error of no more than 3–4%.

Nuclear Power Plant Economics

Refer also to abstracts 29096 and 32594–32598.

32556 (FRNC-R-37) ENERGY CONSUMED AND ENERGY SUPPLIED BY A NUCLEAR POWER STATION. (Electricite de France, 75- Paris). 24 Feb 1975. 7p. (In French). INIS.

In the building and fuel supply of a nuclear power station, energy is required for the working of materials, the machining, transport and mounting of equipment and the reprocessing of spent fuels. These quantities of energy are compared with that produced by the station during operation. The results obtained were established with a lower energy price limit. In view of the mode of calculation, it follows that the energy consumed to produce nuclear energy is over-estimated. (FR)

32557 (INIS-mf-1852) ANNUAL REPORT 1974. (Eldorado Nuclear Ltd., Ottawa, Ontario (Canada)). [nd]. 15p. INIS.

A financial statement, and data on mining, health and safety, operations at Port Hope, R & D, marketing, and exploration are given for Eldorado Nuclear Ltd. for the year ending Dec. 31, 1974. (ECB)

32558 (NP-20833) NUCLEAR ENERGY: 1975. (Iowa Energy Policy Council, Des Moines (USA)). 2 May 1975. 59p. Iowa Energy Policy Council, Des Moines $1.00.

Included are chapters on the growth of nuclear energy, nuclear power plants, the nuclear fuel cycle, and comparison with alternative power sources.

32559 PROBLEMS IN ELECTRIC SUPPLY. Schulte, R. Elektrotech. Z., A; 96: No. 9, K125-K127(Sep 1975). (In German)

From VDEW meeting; Hamburg, F. R. Germany (3 Jun 1975).

The article reports on the problems on nuclear power stations and their financing for an efficient power economy. A reform of the legislation on energy economy and the protection of the general public by unbiased information are also recommended. (DE)

32560 STEAM GENERATION IN THERMAL POWER PLANTS. Spalthoff, F. J. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Essen (F. R. Germany)). Energiewirtsch. Tagesfragen; No. 9/10, 465-466(Sep 1975). (In German).

The economic principles of steam generation are explained with special regard to nuclear steam generators.(DE)

32561 NUCLEAR POWER TODAY AND TOMORROW. Meister, R. (Hamburgische Electricitaets-Werke A. G. (F. R. Germany)). VGB Kraftwerkstech.; 55: No. 10, 640-646(Oct 1975). (In German).

Following a brief survey on the development so far, trends of nuclear power generation until the end of the century are presented considering the total problem of future energy production and its increase. The most important contribution to this is expected from the high-temperature reactors. Large nuclear power centers are planned from 1995 onwards to produce hydrogen and electricity. (DE)

32562 DESIGN OF FISH CONSERVING INTAKE SYSTEM. Downs, D. I.; Meddock, K. R. (South Calif Edison Co, Rosemead). J. Power Div., Am. Soc. Civ. Eng.; 100: No. 2, 191-205(Dec 1974).

Biological tests were conducted to determine behavioral characteristics of salt-water fish indigenous to southern California. The results of the tests were incorporated in the design of a new intake and screenwell for coastal generating stations. Model tests show that the new offshore intake design will greatly reduce the fish entrainment problem. For those fish that are entrained, when they reach the screenwell they will be guided to a holding chamber, removed by an elevator bucket, and returned to the ocean. Earlier fish conservation methods are presented along with the biological tests and the development of the new designs. Confirming model test results are presented. These new designs will first be used at the San Onofre Nuclear Generating Station, Units 2 and 3, scheduled for operation in the early 1980's.

32563 2000 AD. Electrical Power in Great Britain. Allibone, T. E. Electron. Power; 20: No. 16, 685-687(19 Sep 1974).

Electricity consumption should continue to rise despite a constant population. The United Kingdom has selected the steam-generating heavy-water reactor from the options available to satisfy a proportion of this demand. Both the timing of the decision and the choice of a reactor are questionable.

32564 THE DATA AND EXPERIENCE FEEDBACK TO MAINTAIN AND IMPROVE THE RELIABILITY AND PRODUCTIVE CAPACITY OF POWER PLANTS. Fehndrich, W.; Kutsch, W.; Vetterkind, D. (Rheinisch-Westfaelisches-Elektrizitaetswerk A. G., Essen (F. R. Germany). Abt. Waermewirtschaft). Tech. Ueberwach.; 16: No. 7/8, 216-221(Jul 1975). (In German).

From conference on technical reliability; Nuernberg, F. R. Germany (26 May 1975). 6 figs.; 8 refs.

The availability and reliability characteristic quantities in the electrical energy economy, the determination, separation and evaluation of damage data and investigations on causes of damage, the feedback for the predetermination of the availability, and the influence of preventive maintenance on the plant availability are examined. (DE)

32565 NUCLEAR HEAT. Schulten, R. (Technische Hochschule Aachen (F. R. Germany); Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). pp 63-68 of Ways of Closing the Energy Gap. Rau, J. (Ministerium fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Duesseldorf (F. R. Germany)); Peters, W. (Bergbau-Forschung G.m.b.H., Essen (F. R. Germany)); Schubert, E. (Gelsenwasser A. G., Gelsenkirchen (F. R. Germany)); Knizia, K. (Vereinigte Elektrizitaetswerke Westfalen A. G. (VEW), Dortmund (F. R. Germany)); Krieb, K. H. (Steinkohlen-Elektrizitaet A. G. (STEAG), Essen (F. R. Germany)); Dibelius, G. (Technische Hochschule Aachen (F. R. Germany)); Schulten, R. (Technische Hochschule Aachen (F. R. Germany); Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)); Opitz, M.; Pichler, H. Dortmund, F. R. Germany; Verkehrs- und Wirtschaftsverl. Borgmann (1974). (In German)

A short survey is given on the possible applications of nuclear heat, especially those in the energy distribution: 1) coal gasification, 2) methane fission, 3) hot water transport and 4) thermal water fission. Furthermore, it is shown how a coupling of these 4 kinds of energy transport is possible in a future energy economy. (DE)

32566 HOW MUCH SECURITY IS ENOUGH. Cherico, P. J. Power Eng.; 80: No. 2, 40-45(Feb 1976).

A brief discussion of nuclear power plant security includes comments on government agency assistance, planning, security components, intrusion/detection devices, metal and explosive detectors, access control equipment, closed circuit television, fire and radiation protection, security personnel, guardhouse design, regulations, construction security, and plant personnel screening. (DG)

32567 COST OF MEETING SECURITY NEEDS. Rittenhouse, R. C. Power Eng.; 80: No. 2, 46-49(Feb 1976).

Results are presented of a study conducted to determine the expected costs of a nuclear power plant security system designed to meet tentative federal requirements. Stems considered included perimeter fence and sensors, guardhouse, card reader, and special alarm system. (DG)

32568 LOCATING NUCLEAR POWER PLANTS UNDERGROUND. Scott, F. M. (Harza Engineering Co., Chicago). Environ. Lett.; 9: No. 4, 333-353(1975).

The paper reviews some of the questions that have been asked by experts and others as to why nuclear power plants are not located or placed underground. While the safeguards and present designs make such installations unnecessary, there are some definite advantages that warrant the additional cost involved. First of all, such an arrangement does satisfy the psychological concern of a number of people and, in so doing, might gain the acceptance of the public so that such plants could be constructed in urban areas of load centers. The results of the studies are presented and some of the requirements necessary for underground installations described, including rock conditions, depth of facilities, and economics. (auth)

32569 JAPANESE NUCLEAR INDUSTRY AT THE LANDING. Challenge to Nuclear Power Generation Age. Genshiryoku Chosa Jiho; No. 25, 1-64(May 1974). (In Japanese).

In JAIF's investigation into the actual condition of the nuclear industry in Japan in fiscal year 1972, a detailed analysis is described about the trends of expenditure, sales and personnel, and future perspective. The expenditure in 1972 of the industry reached to 125.9 billion yen. A most different point as compared with other industries is its high rate of expenditure for research and development, 11.9%. The sales in 1972 reached to 117.8 billion yen. Number of personnel in the private enterprises related to nuclear industry as of the end of fiscal year 1972 is recorded to be 24243. It seems that the private enterprises are training engineers and technicians for future large scale development. The nuclear industry seems to be forecasting very cautiously at present due to the delay of ordering because of the location problems from environmental pollution and safety. (INIS)

32570 POTENTIAL ROLE OF NUCLEAR POWER IN DEVELOPING COUNTRIES. Woite, G. Int. At. Energy Agency Bull.; 17: No. 3, 21-32(Jun 1975).

A description is presented of the methodology used and results obtained in studies performed by the IAEA to assist member states in their nuclear power planning activities.

32571 NUCLEAR POWER GROWTH AND FUEL REQUIREMENTS, 1975-2000. Goodman, E.; Krymm, R. Int. At. Energy Agency Bull.; 17: No. 3, 5-20(Jun 1975).

Recent forecasts of the nuclear capacity expected to be in operation in the world over the next 25 years are briefly reviewed. An analysis of the margins of uncertainty affecting nuclear power forecasts leads to the selection on a probable and a maximum estimate, on the basis of which uranium and enrichment requirements are derived and compared with present and potential sources of supply.

32572 ENERGY DYNAMICS OF AN EXPANDING POWER GENERATING SYSTEM. Sauter, G. D. (Univ. of California, Livermore). IEEE Trans. Nucl. Sci.; NS-23: No. 1, 60-64(Feb 1976).

From 22nd nuclear science symposium and 7th nuclear power systems symposium; San Francisco, CA, USA (19 Nov 1975).

A computer program was developed to study the magnitude and time dependence of the net power and net energy generated by an expanding system of identical power plants. Application of the program to several expansion modes over a range of values for the rate of expansion, the net energy generated by an individual plant, and the construction time for each plant has led to some interesting results concerning the impact of the expanding system on the overall energy picture. In particular, during a rapid expansion phase, the system of power plants may be a better means of energy storage than of energy generation.

32573 METHODS OF MATHEMATICAL MODELING AND OPTIMIZATION OF ATOMIC POWER INSTALLATIONS. Polyrin, L. S. At. Energ. (USSR); 40: No. 2, 145-151(Feb 1976). (In Russian)

The present status and prospects of the mathematical modeling method, applicable to the peculiarities of its use for complex optimization of atomic power installations, is analyzed.

32574 PROGRESS OF NUCLEAR INDUSTRY DURING FIFTEEN YEARS. Analysis of Results of Investigation Into Nuclear Industry. Genshiryoku Chosa Jiho; No. 21, 17-58(May 1973). (In Japanese)

This investigation has been carried out at a fixed time annually to obtain information useful for the establishment of reinforcement policy for the basis of Japanese nuclear industry. The investigation has been started in 1956, and now in 1970, 15 years elapsed. The industry was at the developing and preparing stage during the first 10 years. Then it entered the practical stage, and its expenditure, sales, and personnel have significantly increased due to the successive start of nuclear power plant construction. Detailed analysis is given for the expenditure, sales, and personnel from different angles, and a prediction is made on the number of personnel in the future. However, the industry is still being operated with "red ink" finance, as the sales exceeded expenditure only in 1963 and 1969.

Reactor Fuel Cycle Economics

Refer also to abstract 32361.

32575 NUCLEAR FUEL CYCLE TECHNIQUES. Pecqueur, M. (CEA, 75- Paris (France)); Taranger, P. (CEA Direction des Productions, 92- Chatillon (France)). Entropie; 11: No. 63, 18-27(1975). (In French).

The production of fuels for nuclear power plants involves five principal stages: prospecting of uranium deposits (on the ground, aerial, geochemical, geophysical, etc.); extraction and production of natural uranium from the deposits (U content of ores is not generally high and a chemical processing is necessary to obtain U concentrates); production of ^{235}U enriched uranium for plants utilizing this type of fuel (a description is given of the gaseous diffusion process widely used throughout the world and particularly in France); manufacture of suitable fuel elements for the different plants; reprocessing of spent fuels for the purpose of not only recovering the fissile materials but also disposing safely of the fission products and other wastes. (FR)

32576 SOME ASPECTS OF NUCLEAR FUEL ECONOMICS. Timm, M. (Hamburg Electricitaets-Werke AG). At. Energy Rev.; 13: No. 4, 695-742(Dec 1975).

The economic aspects of nuclear fuel are reviewed based on the year 1975. The focus of attention is on the well-established light-water reactors, which for the time being, and also for the foreseeable future, account for the bulk of the world's nuclear power capacity. The author describes the principal economic aspects of the light-water fuel cycle components and discusses their future development to the extent that this can be foreseen. Various approaches to the formulation of the contract for the supply of light-water fuel are discussed on the basis of the established procedure. After some introductory comments on methods of calculating specific fuel costs, the author describes the main results of fuel cycle calculations.

Reactor Licensing and Regulation

32577 (DOCKET-50267-436) FORT ST. VRAIN NUCLEAR GENERATING STATION. Semiannual Operations Report No. 4, July–December 1976. (Public Service Co. of Colorado, Denver (USA)). 1976. 65p. Dep. NTIS $4.50.

Operations including changes in facility design, procedures, tests, experiments, and personnel are described. Information is presented concerning training, surveillance, maintenance, primary coolant chemistry, occupational personnel radiation exposures, radioactive effluents, and environmental monitoring. The reactor was shut down during the entire period. (FS)

32578 (DOCKET-50331-614) DUANE ARNOLD ENERGY CENTER, UNIT 1. Semiannual report, July–December 1975. (Iowa Electric Light and Power Co., Cedar Rapids (USA)). 26 Feb 1976. 226p. Dep. NTIS $8.00.

Net electrical power generated was 1,297,280 MWh(e) with the reactor on line 3,770.5 hrs. Information is presented concerning operations, power generation shutdowns, corrective maintenance, primary coolant chemistry, occupational radiation exposure, release of radioactive materials, changes, tests, and radiation and nonradiation environmental monitoring. (FS)

32579 (FIND-50320-R1) FIND: THREE MILE ISLAND NUCLEAR STATION, UNIT 2. Moore, M. M. (ed.). (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1976. 25p. Dep. NTIS $3.50.

This index is presented as a guide to microfiche items 1 through 182 in Docket 50320. This Docket was assigned to the Application, made by Metropolitan Edison Company, Jersey Central Power and Light Company, and Pennsylvania Electric Company, to construct and operate Three Mile Island Nuclear Station Unit 2. Material received from April 29, 1968 through October 22, 1975 is included.

32580 (FIND-50346-R1) FIND: DAVIS–BESSE NUCLEAR POWER STATION. Williams, W. H. (ed.). (Nuclear Regulatory Commission, Washington, D. C. (USA)). Mar 1976. 28p. Dep. NTIS $4.00.

This index is presented for microfiche items 1–179 (excluding items 164 and 170), dated Aug. 1969–Nov. 26, 1975, of Docket 50346, Davis–Besse Nuclear Power Station. The material includes that submitted by Toledo Edison Company in behalf of itself and Cleveland Electric Illuminating Company, in conjunction with their applications to build and later operate Davis–Besse. Also included is correspondence from NRC and various agencies concerning application review.

32581 (FIND-STN-50447-R1) FIND: STANDARD SAFETY ANALYSIS REPORT (GESSAR-238). Hendricks, P. L. (ed.). (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1976. 23p. Dep. NTIS $3.50.

This index is presented as a guide to microfiche items in Docket STN-50447, which was assigned to the BWR/6 STANDARD SAFETY ANALYSIS REPORT (GESSAR-238) submitted by General Electric Company, San Jose, California. The report describes and analyzes a standard BWR/6 boiling water reactor with a Mark III containment system designed for initial operation at approximately 3579 MW(t) with a net electrical output of approximately 1220 megawatts.

32582 (FIND-STN-50491) FIND: CHEROKEE NUCLEAR STATION, UNITS 1, 2, AND 3. Carter, E. P. (ed.). (Nuclear Regulatory Commission, Washington, D. C. (USA)). Mar 1976. 25p. Dep. NTIS $3.50.

A three-part guide is given for the microfiche of DOCKET-STN-50491 items, which have been received and filmed in the USERDA Technical Information Center (TIC) through October 1975: (1) a numerical list of items 1–94 for Units 1, 2 and 3 of Cherokee Nuclear Station, currently in the construction-permit stage; (2) a categorized list by document groupings; and (3) an analytical index (citing specific sheets and grid coordinates within the microfiched items) of the major reports of the application [general information, the safety analysis report (SAR), the environmental report (ER), and the antitrust information] and the commission review [the final environmental statement (FES)].

32583 (FIND-STN-50531) FIND: STANDARD SAFETY ANALYSIS REPORT (GESSAR-251). Moore, M. M. (ed.). (Nuclear Regulatory Commission, Washington, D. C. (USA)). Mar 1976. 20p. Dep. NTIS $3.50.

This index is presented as a guide to microfiche items 1 through 36 in Docket STN-50531 which was assigned to General Electric Company's Standard Safety Analysis Report (GESSAR-251). Information received from February 13, 1975 through December 19, 1975 is included.

32584 (FIND-STN-50545) FIND: REFERENCE SAFETY ANALYSIS REPORT (RESAR-3S). Hendricks, P. L. (Ed.). (Nuclear Regulatory Commission, Washington, D. C. (USA)). Mar 1976. 11p. NTIS.

This index is presented as a guide to microfiche items 1 through 9 in Docket STN-50545, which was assigned to Reference Safety Analysis Report (RESAR-3S) submitted by Westinghouse Electric Corporation, Pittsburgh, Pennsylvania. RESAR-3S describes the Westinghouse standardized four-loop, single-unit nuclear steam supply system for a pressurized water reactor.

32585 (INIS-mf-) STUDY OF THE LEGAL PROBLEMS RAISED BY THE SITING OF NUCLEAR POWER STATIONS IN ARTIFICIAL ISLANDS. Hebert, J.; Guieze, J. L. (Electricite de France, 75- Paris. Div. du Droit Nucleaire; Electricite de France, 75- Paris. Direction de l'Equipement). 1975. 15p. (In French). INIS.

From colloquium on nuclear law and law of the sea; Paris, France (12 Jun 1975).

Colloquium organized by the Centre d'Etudes et de Recherches de Droit International and the Centre d'Etudes du Droit de l'Energie Atomique.

The creation and operation of a nuclear power station on an artificial island in French waters are governed by domestic law and are subject to two types of procedure: the first concerns erection of the artificial island and the second the control of the public authorities over creation and operation of the nuclear power station. At administrative level, the setting up of an artificial island requires that it be attached to a commune as well as permission for occupancy from the maritime authorities. Furthermore, setting up of a nuclear power station on an artificial island is subject to the licensing procedure for large nuclear installations and to delivery of the licenses required for release

of gaseous and liquid radioactive effluents. Given the proximity of the high seas and eventually, the borders of other States, siting of a nuclear power station on an artificial island imposes obligations at international level. These requirements, which concern prevention of transfrontier pollution, stem from the London (1972) and Paris (1974) Conventions on marine pollution. The third party liability regime for a nuclear incident caused by an installation sited in territorial seas is that of the 1960 Paris Convention on third party liability in the nuclear field and the 1963 Brussels Supplementary Convention. Another problem likely to be raised is that of the right of innocent passage of ships near such installations. (FR)

32586 (NUREG/PRDI-76/2) POWER REACTOR DOCKET INFORMATION. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1976. 42p. TIC $1.85.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the U. S. Nuclear Regulatory Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name.

32587 (NUREG/PRDI-76/3) POWER REACTOR DOCKET INFORMATION. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Mar 1976. 123p. TIC $1.85.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the U. S. Nuclear Regulatory Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name.

32588 (PB-239873) CONSTRUCTION STATUS OF NUCLEAR POWER PLANTS: DATA FOR DECISIONS, MANAGEMENT BY OBJECTIVES. Status Summary Report. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Management Information and Program Control). 1975. 12 issues, vp. (NUREG-75/030). Paper copy available $100/year, single copy $10.00.

This monthly report, a part of the Management Information system of the Nuclear Regulatory Commission (NRC), presents data used by the NRC to monitor construction of nuclear power plants. Scheduling information for each unit under construction is presented in a network diagram, along with details on items affecting NRC's decision as to whether an operating license should be issued. The report also contains summary data on stages of reactor construction, slippages in fuel loading dates, and fuel load projections for all units under construction. (GRA)

32589 (PB-239874) OPERATING UNITS STATUS REPORT: LICENSED OPERATING REACTORS, DATA FOR DECISIONS. Status Report. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Management Information and Program Control). 1975. 12 issues, vp. (NUREG-75/020). Paper copy available $100/year, single copy $10.00.

This monthly report, a part of the Management Information System of the Nuclear Regulatory Commission (NRC), presents operating statistics for all of the commercial nuclear power reactors in the United States. It contains summary monthly and year-to-date data on power generation, outages, availability, and capacity, as well as comparative performance statistics on fossil and nuclear units. It also includes specific information on each reactor, as submitted by the licenses and the NRC regional offices, regarding items such as inspection status, average daily power level, operating status (monthly, year-to-date, and cumulative), unit shutdowns, and power reductions. (GRA)

32590 THE PROBLEMS OF PROPERTY WITH REGARD TO SPECIAL FISSIONABLE MATERIALS. Possible Solutions Under Community Law and Under National Law. Everling, U. (Bundesministerium fuer Wirtschaft, Bonn (F. R. Germany)). pp 89-97 of 2nd German Nuclear Law Symposium. Lectures and Contributions to the Discussion on Problems Arising from the Possession of Special Fissionable Materials Taking into Account the Economic Consequences on the Energy Supply. Lukes, R. (ed.) (Muenster Univ. (F. R. Germany). Inst. fuer Arbeits- und Wirtschaftsrecht). Koeln, F. R. Germany; Heymanns (1974). (In German).

From 2nd German nuclear law symposium; Duesseldorf, F. R. Germany (15 May 1974). 12 refs.

The problem of what practical measures can be taken to overcome the difficulties in nuclear power plant financing arising from the regulation concerning the EC property in special fissionable material is discussed. (DE)

32591 SUPPLEMENTARY QUALITY ASSURANCE REQUIREMENTS FOR INSTALLATION, INSPECTION, AND TESTING OF STRUCTURAL CONCRETE AND STRUCTURAL STEEL DURING THE CONSTRUCTION PHASE OF NUCLEAR POWER PLANTS. Hinesdale, IL; American Nuclear Society (1974). 12p.

This standard sets forth the supplementary quality assurance requirements for installation, inspection, and testing of structural concrete and structural steel for nuclear power plant construction. The requirements may also be extended to other appropriate parts of nuclear power plants when specified in contract documents. This standard is intended to be used in conjunction with ANSI N45.2.

32592 REQUIREMENTS FOR COLLECTION, STORAGE AND MAINTENANCE OF QUALITY ASSURANCE RECORDS FOR NUCLEAR POWER PLANTS. Hinesdale, IL; American Nuclear Society (1974). 11p.

This standard provides general requirements and guidelines for the collection, storage, and maintenance of quality assurance records associated with the design, manufacture, construction, and operation phase activities of nuclear power plants. It is not intended to cover the preparation of the records, nor to include working documents not yet designated as quality assurance records.

32593 NUCLEAR INSTALLATIONS, RADIATION PROTECTION REGULATIONS, PT. 4. Radiation Protection Regulations, Pt. 4. Vychytil, P. (Bundesministerium fuer Gesundheit und Umweltschutz, Vienna (Austria)). pp 41-42 of Physical Radiation Protection Control in Accordance with the Austrian Radiation Protection Law and Regulations. Annual Meeting 1972 of the Austrian Association for Radiation Protection, Vienna (Austria), 22 June 1972. Boese, A.; Sorantin, H. (Eds.). Vienna; OEVS (1973). (In German)

From annual meeting 1972 of the Austrian Association for Radiation Protection; Vienna, Austria (22 Jun 1972). Available from Oesterreichischer Verband fuer Strahlenschutz, Lenaugasse 10, A-1082 Vienna (Austria).

The abstract of the fourth part of the radiation protection regulations deals with nuclear installations, their construction, licensing, operation, performance and the various safeguards to be observed.

GENERAL AND MISCELLANEOUS

Law

32594 THE FINANCIAL IMPORTANCE. Diel, R. (Dresdner Bank A. G., Duesseldorf (F. R. Germany)). pp 7-15 of 2nd German Nuclear Law Symposium. Lectures and Contributions to the Discussion on Problems Arising from the Possession of Special Fissionable Materials Taking into Account the Economic Consequences on the Energy Supply. Lukes, R. (ed.) (Muenster Univ. (F. R. Germany). Inst. fuer Arbeits- und Wirtschaftsrecht). Koeln, F. R. Germany; Heymanns (1974). (In German).

From 2nd German nuclear law symposium; Duesseldorf, F. R. Germany (15 May 1974). 10 refs.

The question of how the EURATOM property in special fissionable materials as specified in article 86 of the EURATOM treaty has to be treated by German law and which effects the decisions to be made will then have on the borrowing of money by nuclear power plant operators as well as on the collateral for this borrowed money are discussed. It is mandatory for all parties to reach a consensus of opinion regarding these matters in order to guarantee a legally irreproachable collateral for the money to be borrowed. The influencing factors from the fields of civil, public, and international law will have to be coordinated in consideration of the powers of the EURATOM community. (DE)

32595 THE PROBLEMS FROM THE PUBLIC UTILITIES' POINT OF VIEW. Scheuten, G. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Essen (F. R. Germany)). pp 17-20 of 2nd German Nuclear Law Symposium. Lectures and Contributions to the Discussion on Problems Arising from the Possession of Special Fissionable Materials Taking into Account the Economic Consequences on the Energy Supply. Lukes, R. (ed.) (Muenster Univ. (F. R. Germany). Inst. fuer Arbeits- und Wirtschaftsrecht). Koeln, F. R. Germany; Heymanns (1974). (In German).

From 2nd German nuclear law symposium; Duesseldorf, F. R. Germany (15 May 1974).

Development of the primary energy demand of the FRG is reviewed and the nuclear fuel market until 1985 is analyzed. With regard to article 86 of the EURATOM treaty, a civil-law interpretation is called for, which enables the industry to offer the economic value of nuclear fuel as a security for loans legally, irreproachably, safely, dependently or independently. (DE)

32596 THE FUEL CYCLE. Stephany, M. (Nuklear-Chemie und - Metallurgie G. m. b. H. (NUKEM), Grossauheim (F. R. Germany)). pp 21-34 of 2nd German Nuclear Law Symposium. Lectures and Contributions to the Discussion on Problems Arising from the Possession of Special Fissionable Materials Taking into Account the Economic Consequences on the Energy Supply. Lukes, R. (ed.) (Muenster Univ. (F. R. Germany). Inst. fuer Arbeits- und Wirtschaftsrecht). Koeln, F. R. Germany; Heymanns (1974). (In German)

From 2nd German nuclear law symposium; Duesseldorf, F. R. Germany (15 May 1974). 8 figs.; 3 tabs.

A short survey is given on the problems of the fuel cycle of BWR and PWR type reactors. There are not only problems of nuclear power plant financing but also financing problems in processing with regard to fuel as well as to the installations required for processing. The public utilities and their financing enterprises must get used to the fact that the fuel elements acquire a negative value which has to be taken into consideration in their calculations, i.e., they can no longer assume that objects of the invested and circulating capital always retain a positive value and that a depreciation of up to 100% is therefore sufficient. (DE)

32597 THE EURATOM TREATY REGULATIONS CONCERNING THE PROPERTY IN SPECIAL FISSIONABLE MATERIALS. Lukes, R. pp 35-82 of 2nd German Nuclear Law Symposium. Lectures and Contributions to the Discussion on Problems Arising from the Possession of Special Fissionable Materials Taking into Account the Economic Consequences on the Energy Supply. Lukes, R. (ed.) (Muenster Univ. (F. R. Germany). Inst. fuer Arbeits- und Wirtschaftsrecht). Koeln, F. R. Germany; Heymanns (1974). (In German).

From 2nd German nuclear law symposium; Duesseldorf, F. R. Germany (15 May 1974). 114 refs.

The legal position of the EC in the field of special fissionable materials as specified under article 197, subparagraph 1, in consideration of article 86 of the EURATOM treaty, and the contents of this so-called property are discussed. The present state of opinions are summarized, an investigation was made of the legal position of the community and the contents of the so-called property of the community on the basis of an objective interpretation of the law, and also a solution is attempted for special cases now under discussion in which the application of the law is discussed. An outline is given on the fundamentals and consequences of the securing of a credit in connection with the problem of ownership. (DE)

32598 THE PROBLEM OF PROPERTY WITH REGARD TO THE FUTURE DEVELOPMENT OF NUCLEAR ENERGY. Loosch, R. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany)). pp 83-88 of 2nd German Nuclear Law Symposium. Lectures and Contributions to the Discussion on Problems Arising from the Possession of Special Fissionable Materials Taking into Account the Economic Consequences on the Energy Supply. Lukes, R. (ed.) (Muenster Univ. (F. R. Germany). Inst. fuer Arbeits- und Wirtschaftsrecht). Koeln, F. R. Germany; Heymanns (1974). (In German).

From 2nd German nuclear law symposium; Duesseldorf, F. R. Germany (15 May 1974).

What measures can be taken to ensure that the necessary governmental control of the peaceful use of nuclear energy does not more than necessary interfere with the object pursued by the public support measures (in connection with the problems of the community property as specified under article 86 ff, EURATOM treaty) are discussed. (DE)

32599 1976 ERDA AUTHORIZATION. Hearings Before the Subcommittee on the Environment and the Atmosphere, of the Committee on Science and Technology, United States House of Representatives, Ninety-Fourth Congress. First Session, February 26, 27, 1975. Washington, DC; Committee on Science and Technology (1975). 146p. GPO.

A transcript of congressional hearings on ERDA budget for fiscal 1976 is presented. Special witnesses include James L. Liverman, Acting Deputy Assistant Administrator for Environment and Safety; Russell E. Train, Administrator, Environmental Protection Agency; and Russell Peterson, Chairman, Council on Environmental Quality. (PCS)

Management

32600 (INIS-mf-1918) THE ORGANISATION AND WORK OF THE NRPB. (National Radiological Protection Board, Harwell (UK)). 1975. 12p. INIS.

Also available from the National Radiological Protection Board, Harwell.

The functions and powers, the organisational structure, and financial arrangements of the National Radiological Protection Board (UK), created in 1970, are stated. One of the functions of the board is to advance by research or otherwise the acquisition of knowledge about the protection of mankind from radiation hazards. Work is surveyed which is being carried out: In the Research and Development Division on; the metabolism of plutonium, removal of plutonium from the body, ^{14}C studies, inhalation studies, chromosome aberration studies, neutron studies, thermoluminescence, applied physics, computer techniques. In the Operations Division on; environmental radiation and public health, health physics measurements, instrumentation, medical equipment, advisory services, reviews of design of laboratories and installations, monitoring of premises, personal monitoring, instrument calibration and testing, tests on materials and equipment, training, incidents and accidents. In the Medical Division on; population exposures from medical radiology, occupational radiation exposure. (INIS)

32601 (NP-20854) THE NUCLEUS. Annual Review of the Science Foundation for Physics and the School of Physics Within the University of Sydney. (Sydney Univ. (Australia)). Mar 1975. 25p. Dep. NTIS (US Sales Only) $3.50.

Research programs are outlined for the following departments; theoretical physics, nuclear physics, plasma physics, astronomy and astrophysics.

32602 VOCATIONAL TRAINING AND FURTHER TRAINING OF X-RAY TECHNICIANS AND LABORATORY ASSISTANTS IN THE USSR. Tikhonov, K. B.; Mil'man, N. Ya. Radiol. Diagn.; 15: No. 5, 697-704(Sep 1974). (In German).

The authors report on their comprehensive methodological and organizational work done for many years and their experiences gathered about the qualification of X-ray laboratory assistants and technicians. A system of training and further training was developed and introduced into practice. The work of x-ray laboratory assistants and therewith the radiological care of the population is essentially improved by the elaboration of suitable teaching materials as to atlases, compendia, methodological instruction, by the organization and performance of conferences, courses and training-colleges.

32603 TRAINING OF X-RAY TECHNICIANS IN THE USSR. Tikhonow, K. B.; Mil'man, N. Y. Mod. Roentgen-Fotogr.; (1) p. 1-9: (1975). (In German).

A survey is given of the historical development of training of X-ray technicians and lower graduated radiological personnel in the USSR since the foundation of the Petersburg X-ray institute in 1918. The present ways of education are briefly described.

Mathematics and Computers

Refer also to abstracts 28984, 28997, 29448, 29450, 29455—29459, 31649, and 31650.

32604 (JINR-10-7806) EDITING IN THE BESM-4 COMPLYING SYSTEM. Gal'perin, A. G.; Zaginajko, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 10p. (In Russian). INIS.

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

NUCLEAR SCIENCE ABSTRACTS

Volume 33

Numbers 7-12

Abstracts 14226-32604

April-June

1976

Office of Public Affairs

STAFF OF NUCLEAR SCIENCE ABSTRACTS

Editor and Production Manager
David E. Bost

Assistant Editor
Lee M. Thompson

Associate Editors
M. Catherine Grissom
Robert C. Kelly
Sidney F. Lanier
Henry D. Raleigh
Charles E. Stuber

Report Evaluators
John H. Mitchell
Mary H. Newman
Ted Redmon

Descriptive Cataloging Specialist
J. Paul Meredith

Subject Heading Specialist
Dora H. Moneyhun

Corporate Author Specialist
Clara L. Fox

Report Number Specialist
Helen W. White

Information Specialists
P. Martin Alexander
Dianna D. Altom
E. Ray Bedford
Jane G. Buchanan
D. Lamar Cason
David C. Cunningham
Theodore F. Davis
James R. Dulaney
Stanley D. Frey
Darrell O. Galde
Martha W. Gerrard
Barbara J. Glenn
Everett J. Hoffman
Carolyn D. Houston
Lynda H. Kern
W. Hugh Kinser
Lisbeth C. Lieberman
William D. Matheny
Betty L. McDowell
Lorne T. Newman
Jean F. Peckham
Mona H. Raridon
Julia S. Redford
Stanley J. Rimshaw
Jessie W. Rushing
Robert W. Rutkowski
Francis L. Sachs
Lila B. Smith
Polly C. Summers
George H. Thoeming
Helen L. Ward
Lawrence T. Whitehead
Milton O. Whitson
Martha C. Wilson

Publishing Coordinator
Charles R. Bruce

Computer Processing Coordinator
Noboru Kawakami

Communication concerning the editorial policy and content of *Nuclear Science Abstracts* should be addressed to the Editor, *Nuclear Science Abstracts*, USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

The Administrator of the Energy Research and Development Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.

COMPLETE OR PARTIAL COLLECTIONS OF ERDA REPORTS IN COUNTRIES OTHER THAN THE UNITED STATES

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atómica

AUSTRALIA
Canberra, National Library of Australia
Sutherland, New South Wales Atomic Energy Research Establishment

AUSTRIA
Vienna, International Atomic Energy Agency (IAEA)
Vienna, Zentralbibliothek der Physikalischen Institute der Universität

BELGIUM
Brussels, European Atomic Energy Community (Euratom)
Mol-Donk, Centre d'Etude de l'Energie Nucléaire

BRAZIL
Rio de Janeiro, Comissão Nacional de Energia Nuclear
São Paulo, Instituto de Energia Atómica

CANADA
Chalk River, Ontario, Atomic Energy of Canada, Ltd.
Hamilton, Ontario, McMaster University
Ottawa, National Research Council

CONGO, REPUBLIC OF
Kinshasa, Trico Nuclear Center

DENMARK
Risö, Danish Atomic Energy Commission

FINLAND
Otaniemi, Teknillinen Korkeakoulu

FRANCE
Saclay, Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay

GERMANY, WEST
Karlsruhe, Zentralstelle für Atomkernenergie Dokumentation
Munich, Technische Universität

GREECE
Athens, Nuclear Research Center, Democritus Library

INDIA
Bombay, Trombay, Bhabha Atomic Research Center Library

IRAQ, REPUBLIC OF
Baghdad, Atomic Energy Commission, Nuclear Research Institute

IRELAND
Dublin, University College

ISRAEL
Yavne, Israel Atomic Energy Commission, Soreq Nuclear Research Centre

ITALY
Ispra, Cetis Library
Rome, Centro di Studi Nucleari della Casaccia

JAPAN
Tokyo, National Diet Library
Tokai-Mura, Naka-gun, Ibaraki-ken, Japan Atomic Energy Research Institute

KOREA, REPUBLIC OF
Seoul, Atomic Energy Research Institute

MEXICO
Mexico, D. F., Comisión Nacional de Energía Nuclear

NETHERLANDS, THE
Petten, Reactor Centrum Nederland
The Hague, Bibliothek Octrooiraad

NORWAY
Kjeller, Institutt for Atomenergi

PORTUGAL
Sacavem, Junta de Energia Nuclear

SOUTH AFRICA, REPUBLIC OF
Pretoria, Atomic Energy Board Library

SPAIN
Madrid, Junta de Energía Nuclear, Ciudad Universitaria

SWEDEN
Nyköping, Aktiebolaget Atomenergi Library

SWITZERLAND
Zürich, Swiss Federal Institute of Technology

UNITED KINGDOM
Boston Spa, Wetherby, Yorkshire, British Library Lending Division
Harwell, Didcot, Berkshire, Atomic Energy Research Establishment

IN INTERNATIONAL AGENCIES

EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM)
Brussels, Belgium
Ispra, Varese, Italy, Cetis Library

OECD NUCLEAR ENERGY AGENCY (NEA)
British Library Lending Division
Boston Spa, Wetherby, Yorkshire, England

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
Vienna, Austria

UNITED STATES ENERGY RESEARCH
AND DEVELOPMENT ADMINISTRATION
P. O. BOX 62
OAK RIDGE, TENNESSEE 37830

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

POSTAGE AND FEES PAID
U. S. ENERGY RESEARCH
AND DEVELOPMENT ADMINISTRATION

U.S.MAIL

ND FEES PAID
NT PRINTING OFFICE

U.S.MAIL

XEROX UNIVERSITY MICROFILMS
SERIALS DEPT.
300 N. ZEEB ROAD
ANN ARBOR, MI 48106

1

Recent Publication in the ERDA Symposium Series

Atmosphere-Surface Exchange of Particulate and Gaseous Pollutants (1974)

Proceedings of a symposium held at Richland, Washington, September 4–6, 1974
Sponsored by Battelle, Pacific Northwest Laboratories, and Division of Biomedical and Environmental Research, U. S. Atomic Energy Commission

Coordinators
Rudolf J. Engelmann
George A. Sehmel

Published by the Technical Information Center, Office of Public Affairs, Energy Research and Development Administration
1976. 1000 pages, 6 by 9 inches, paper binding
Library of Congress Catalog Card No. 75-38716 (CIP)

Available as CONF-740921 for $13.60 (foreign, $16.10) from National Technical Information Service
U. S. Department of Commerce
Springfield, Va. 22161

Increasing energy demands suggest that air pollution probably could become more serious. For control and for the prediction of possible environmental effects from that pollution, data are needed by those planning national and local energy strategies. Pollution insertion rates and removal rates from local and regional sources must be known. This volume discusses atmospheric removal by dry deposition and insertion rates by resuspension.

Much of this research has been directed toward predicting the behavior of inadvertent emissions from nuclear facilities, but particle motion basically is not controlled by particle toxicity; thus even the nuclear research results apply also to nonnuclear emissions such as fossil-fuel particulates and gaseous sulfur emissions.

The 58 papers in this volume are a state-of-the-art statement of deposition and resuspension.

CEASED PUBLICATION WITH
VOLUME 33, JUNE 1976
ISSUE 12